THE

ABDOMINAL BRAIN

AND

AUTOMATIC VISCERAL GANGLIA

BY

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THIS BOOK IS DEDICATED

TO MY FATHER

WILLIAM ROBINSON

WHOSE LIFE-LONG PRECEPTS WERE INDUSTRY

AND HONESTY

PREFACE.

> Where a truth is made out by one demonstration, there needs no further inquiry; but in all probability where there wants demonstration to establish the truth beyond doubt, then it is not enough to trace one argument to its source, and observe its strength and weakness, but all the arguments, after having been so examined on both sides, must be laid in the balance, one against another; and upon the whole the understanding determines its assent.—*John Locke on the Conduct of the Understanding.*

The present volume contains views concerning the anatomy, physiology and pathology of the abdominal brain and its automatic visceral ganglia. The abdominal brain is the solar plexus of older authors. The book is partly based upon the so-called reflexes, as they are observed in both health and disease. We understand by "reflexes," disturbances in distant parts due to some local irritation. The reflex is the "referred disturbance" of modern writers. The author has attempted to show the extensive utility and dominating influence of the abdominal sympathetic nerves upon the animal economy. The reflexes and rhythm concerning organs under various conditions are discussed. The automatic menstrual ganglia are presented as the peripheral ganglia of the uterus and Fallopian tubes. No attempt has been made to divorce the cerebro-spinal and sympathetic nervous systems from their exquisite mutual dependence. Yet, notwithstanding this latter, the abdominal sympathetic nerves, under observed conditions of defect of the cord and cerebrum, act with a certain degree of independence.

The author does not claim that deep-seated, grave diseases are caused by reflex irritation, nor are these diseases done away with by removal of the reflex or peripheral irritation. However, it may be stated that the chief suffering is not due to deep-seated disease, but to superficial, reflex ir-

ritation, which brings in its train innumerable disturbances capable of unbalancing the complex abdominal visceral system.

The course of reflex irritation may be observed clinically as:—

1. Peripheral (reflex) irritation; 2. Indigestion; 3. Malnutrition; 4. Anemia; 5. Neurosis. The final stage is the irritation of the innumerable abdominal sympathetic ganglia by waste-laden blood, which produces the hysteria, neuroses and neurasthenia.

The author is aware that the present volume does not belong to the stereotyped, systematized text-books; yet he is confident that the thinking reader will find in its pages ample reward for its perusal.

Byron Robinson.

Chicago, Illinois, August, 1898.

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PHYSIOLOGIC AND ANATOMIC CONSIDERATIONS.

CHAPTER I.

A HISTORICAL SKETCH OF THE DEVELOPMENTAL KNOWLEDGE OF THE SYMPATHETIC NERVES.

"The cloud-capped towers, the gorgeous palaces, the solemn temples, the great globe itself, yea all which it inherits shall dissolve and, like the baseless fabric of a vision, leave not a wreck behind."—*William Shakespeare's epitaph, written by his own hand, placed on his statue in Westminster Abbey.*

The sympathetic system of nerves was discovered by Claudius Galen, who was born 131 and died in 201 or 210 A. D. He lived first at Pergamos, and finally at Rome. Galen considered that the sympathetic nerves acted as buttresses to strengthen themselves as they receded from their origin. He studied them in animals and evidently did not know that the sympathetic nerves were a part of the cerebrospinal system. It appears that before his time the sympathetic ganglionic system of nerves was entirely unknown as to their function or nature. Yet doubtless Aristotle viewed them many times in his dissections, and wondered what such white cords and nodules signified. It appears that the Arabians pointed out some views on the sympathetic system.

Galen was the author of the dogma that the brain was the origin of nerves of sensation, and the spinal cord of those of motion. In general medical literature he has the credit of discovering the sympathetic nerve, but as Galen was a practical anatomist (learning his anatomy, however, almost exclusively from animals), he perhaps gave a quite accurate account of the sympathetic, and this became quoted, until he was finally announced to be father and discoverer. Galen gave correct views of the omentum and peritoneum. He seems to have been quite well acquainted with the ganglia on the abdominal nerves.

It is claimed that the sympathetic was known to the Hippocratic school. Hippocrates (460 B. C.-370 B. C.), who practised medicine at Athens, Greece, doubtless saw the sympathetic many times, at least in animals, but did not interpret its functions. Yet he was one of the first to cast tradition, which still lingers, aside, and to practise medicine on inductive reasoning, as a carpenter would measure and build a house, as a physicist would study astronomy.

Erasistratus (340—280 B. C.) believed that all nerves arose from the brain and cord, but doubtless did not recognize the sympathetic nerves as such. It appears, however, that he separated nerves into those of motion and sensation. He studied particularly the shape and structure of the brain.

Herophilus (300 B. C.), it appears, dissected more than all his predecessors, both in man and animals. He first distinguished the nerves from the tendons, which Aristotle confounded. Herophilus gave the duodenum its name (12-inch). He, like Erasistratus, distinguished nerves of motion from those of sensation, and added a careful study of the brain. We all remember his "Torcular Herophili," or wine-press.

Aristotle (384 B. C.), who widely dissected animals while instructing Alexander, the son of King Philip, no doubt saw the sympathetic system frequently, yet did not interpret its significance for he confounded tendons and nerves.

B. Eustachius, an Italian anatomist, dying in 1574, considered that the sympathetic nerves originated from the abducens or 6th cranial nerve. It was not until Thomas Wil-

lis (1622 to 1675), an English physician, appeared in anatomical records that the proper significance of the sympathetic nerves was recognized. Willis looked on the sympathetic system of nerves as an appendage of the cerebrospinal system and represented them as growing from the cerebro-spinal nerves. Many neurologists hold the same opinion to-day as did the able Willis 250 years ago. He viewed the sympathetic nerves as a kind of diverticula for the animal spirits received from the brain. In 1660, while Sedleian Prof. of Philosophy at Oxford, he described the chief ganglia.

Rene Descartes (1569-1650) was one of the first to describe reflex movements from ganglia.

R. Vieussens (1641-1716), a French anatomist, wrote a work entitled "Neurograph" in 1684, in which he adopted the views of Willis, that the ganglionic nerves were appendages of the cerebro-spinal system.

Vieussens wrote of the ganglia of the solar plexus.

Prochaska described the reflex channels.

Duverney (1643-1730) discovered the ciliary ganglia.

J. M. Lancisius (1654-1720), an Italian anatomist, wrote a monograph on the sympathetic nerves, agreeing with the keen Willis as regards structure. His monograph was entitled "Opera Omnia." Lancisi looked upon the sympathetic nerves as a kind of forcing pump adapted to propel the animal spirits along the nerves.

The senior Johann Friedrich Meckel (1714-1774), in his "Memoires de Berlin," 1745, held views on the subject of the sympathetic nerves similar to those of Willis, as did also Johann Gotfried Zinn (1727-1759) in a publication in 1753.

J. B. Winslow (1669-1760), a Dane, Professor of Anatomy in Paris, insisted in his writings on the independence of the sympathetic nerves. Since that time writers have wavered between the opinions of Winslow (independence) and Willis (dependence) in regard to the sympathetic nervous system. Yet up to one hundred years ago actual physiologic and experimental data were quite limited. Bichat, who widely influenced the anatomic world, vigorously proclaimed the independence of the sympathetic ganglia.

Hoare wrote a publication in 1772 on the sympathetic system entitled "De Ganglia Nervorum."

Antoine Scarpa (1752-1832), the Italian anatomist of "Scarpa's Triangle" fame, wrote an essay on the sympathetic system entitled "De Nerv. Gangl." in 1779. This work of course contained the views of previous writers.

Alexander Monro (Monro secundus, 1733-1817), a Scotch anatomist of Edinburgh University, published an essay "On the Structure and Function of the Nervous Ganglia," in 1783. The later writers analyzed more in detail and generalized in a manner superior to that of previous writers, yet all agreed or disagreed with Willis or Winslow.

Johann Friedrich Blumenbach (1752-1840), in "Institutes of Physiology," published views on the sympathetic nerves in 1786. Blumenbach was a German anatomist.

Francois Chaussier (1746-1828), a French surgeon and anatomist, wrote an "Exposition" of the sympathetic nerves in 1807.

In 1812 Legallois wrote "Sur le Principe de la Vie", containing views on the sympathetic nerve.

In 1823 views of the sympathetic nerve appeared in Beclard's "El. d' Anat. Gen."

Georges Cuvier (1769-1832), a famous French naturalist, espoused the doctrine of the independence of the sympathetic nervous system as published in his "Lecons d'Anat. Comp.", 1799.

Xavier Bichat (1771-1802), the master intellect of his day in Paris, professor of anatomy and physiology, the associate and rival of the priestly physician, Pinel, may be heard insisting with his accustomed eloquence upon the independence of the sympathetic nervous system, as noted in his "Sur la Vie et la Mort.", 1802. Bichat represented all the ganglia of this system as the particular center of organic life, that not only were all the ganglia collectively independent, but that each ganglion was independent of every other ganglion, that each nerve proceeding from such a ganglion was in a great measure independent from that ganglion, and even that each point of such nerve was independent of all the rest and consisted of a distinct focus of nervous influence. Bi-

chat's influence is distinctly traceable through subsequent writings on the sympathetic system.

Wilson Philip wrote "On the Vital Functions," in 1817, analogous to the grand center of animal life. He also held views referring to the sympathetic system.

In Mason Good's work "On the Study of Medicine," 1825, views are expressed in regard to the sympathetic nervous system.

Writers on the sympathetic system became more numerous with times subsequent to 1800.

Richerand (Phys. 1804), and Gall (Anat. et Phys. du Syst. Nerv., 1810), adopted similar tenets in regard to the sympathetic nervous system that Bichat did.

Wutzer in 1817 (De Corp. Hum. Gang.) further inculcated Bichat's, Winslow's and Cuvier's views.

Broussais, whose name is indelibly connected with inflammation of the peritoneum, as Bichat's is with establishing the independence of the peritoneum, describes a peculiar kind of sensibility or irritability belonging to the sympathetic nerves with which it immediately endows all organs destined for nutrition, secretion and the other organic functions, and, by means of its repeated connections with the cerebro-spinal system, all organs of the body.

Brachet, in his "Sur les Fonctions du Syst. Nerv. Gang.", 1823, in an especial manner, distinctly represents the ganglionic system of nerves as the seat of "imperceptible sensation" and as presiding in an especial manner over the several viscera of the body. The author, though not acquainted with Richerand's and Bichat's views, worked out the same views from original studies and experiments, but added the idea that the abdominal brain (solar plexus) is the chief organizing center of the abdominal sympathetic.

The preceding views are simply some of the chief landmarks in the progress of the evolutionary development of the knowledge of the sympathetic nerves, in the direction of their function and signification.

The most significant names among the brilliant galaxy of students of the sympathetic nerves are Bichat, Cuvier, Winslow and Brachet.

Le Gallois, a noted neurologist, taught that the spinal cord was the origin of a part of the ganglionic nervous system, but Davy strenuously denies Le Gallois' assertion and remarks that the medical profession never acknowledged it. About 1840 no less distinguished a person than Marshall Hall asserted that the removal of the frog's viscera necessitated that "every portion of the ganglionic system" would also be removed. This showed lack of anatomical facts. But by 1840 such writers as Cuvier, Solly, Bichat, Richerand, Wurtzer, Gall and Broussais claimed that every ganglion of the sympathetic was independent of the remainder and that each ganglion is a distinct focus of nervous influence. It was Broussais (the founder of independent peritoneal inflammation) who claimed that each ganglion presided over the viscera and their functions.

Prochaska and John Hunter asserted that the ganglia of the sympathetic nervous system generated and controlled nervous power. Any one can witness this fact by separating a frog from its heart. The heart will beat for hours alone. The cerebro-spinal nerves together perform the animal functions which prove us to be feeling and thinking and willing beings.

The ganglionic system of nerves, with the abdominal brain as their central organ, performs the vital functions which are independent of mind and present to us the idea of life. The sympathetic system of nerves presides over the viscera—over secretion, nutrition, gestation, expulsion, respiration and circulation—over sub-conscious phenomena.

Muller, Bayly, Rolando, Akermann, Blumenbach and Gall agreed to the following views (by 1840) viz.: The sympathetic system of nerves of the chest and abdomen are fully formed while the brain is yet a pulpy mass. Now, these ganglia of the sympathetic would hardly be formed before the brain and cord if it were not for the sake of the organs which supply and rule. Besides, it may be added that the sympathetic controls the viscera, which are as perfect at birth as in the adult. But the mind and brain are very slowly perfected. The priority of the sympathetic nerves over the cerebro-spinal is evident and signifies their import in

the continuance of the vital forces of life. Babies are born alive with no brains. Dr. Ball of Ohio writes me that he found one baby fully formed without even a medulla oblongata. Marshall Hall records that a fetus was born "without either a brain or spinal marrow, without a particle of either of those organs, yet perfectly developed." Blumenbach furnishes an equal example, when he says, "In fetuses without brain or spinal marrow the circulation, nutrition, secretion, etc., proceed equally as in others, who, besides spinal marrow, nerves and ganglionic nervous system, possess a brain."

Children are born quite well developed without the vestige of a cerebro-spinal system,—only possessing a sympathetic system. It might be argued that often these children originally possessed a cerebro-spinal system, but that through pressure, as hydrocephalic conditions, the fluid had pressed the nerve-cells out of existence. Yet this does not explain all the cases.

In 1872 there appeared one of the best and most reliable books on the sympathetic system of nerves up to that date, by Guttman and Eulenberg. It was translated from the German into the English in 1878 by Dr. C. Napier. This work was based on physiologic and pathologic labors. It is for this essay of Eulenberg and Guttman that the Astley Cooper Prize for 1877 was originally awarded—a decision subsequently, however, overthrown on the technical ground that the essay was the work of two authors and not one only, as the terms of Sir Astley Cooper would seem to require.

In 1802 Wm. Hunter presented the nerves of the uterus; Osiander, also, in 1808-1818, (father and son). Tiedemann (1822) made valuable observations on uterine nerves. Lobstein, in 1823, produced excellent views on the sympathetic. He carefully described the various plexuses by the names we now give them.

In 1839 Robert Lee gave some good descriptions of the sympathetic uterine nerves, as also Snow-Beck (1845) with Clay, Goetz, Schlem, Swan (1846), Killian (1834) and Lambell (1841).

In 1867 a most excellent work was published by Dr. F.

Frankenhauser, entitled, "The Nerves of the Uterus." It contains finely executed tables of the sympathetic nerves of the abdomen.

The sympathetic nervous system is supremely evident when we note the body nourished, the viscera perfected and the bony structures finished, without a brain or cord, and still more evident when we observe the finely balanced circulation, delicate absorption and secretion, in full and perfect operation for nearly a year without a cord or brain—only a sympathetic nervous system to rule. Should the main-spring of life, the abdominal brain, solar ganglion, cease its activity life itself disappears. The sympathetic nerves carry on life's functions during sleep, like the additional spring to a watch which enables it to go while being wound.

By 1850 the physician had not lost sight of the fact that the sympathetic nerve, being so intimately associated with the vital action of every viscus, could become involved in disease. For the past fifty years the pathology of the sympathetic has been studied. In the work of Davy may be found numerous diseases attributed to the sympathetic. Dr. Marshall Hall stated that: "The ganglionic system is that power under which all formation, all nutrition, all absorption and all secretions are performed; therefore, that being affected may affect different acts."

The opinions of men famous, though dead, still prevail. Bidder produced a celebrated article, in Muller's Archives for Physiology, in 1844, entitled: "Experience over the functional independence of the sympathetic as the center of motion and sensation for all the vegetative organs." Volkmann assumed the same views as Bidder in his well-known article: "The Independence of the Sympathetic Nervous System demonstrated through Anatomical Investigations" (1842). Prof. Albert V. Kölliker of Wurtzburg, who is now celebrating his fifty year jubilee as a medical teacher, assumed an intermediate ground between Bidder and Volkmann, when in 1845 he wrote his article entitled, "The Independence and Dependence of the Sympathetic Nervous System Demonstrated by Anatomical Observation." Budge

in 1864 gave some reliable data in regard to the nerves of the bladder, in Henle's and Pfeufer's "Landschrift für rationalle Medicin," as did also Gianozzi in 1863.

The history of the developmental knowledge of the sympathetic is not complete without the names of Schiff, Henle, Ludwig, Heffer and especially the often quoted experiments of Nasse found in his article: "Lecture on the Physiology of Bowel Motion," Leipzig, 1866. Henle stated in 1840 that the peristalsis of the intestines was due to ganglia scattered among the intestinal nerves. Brown-Sequard, Pickford, Remak (1864), Jastrowitz (1857), Rochefontaine, Tarchanoff, Pflueger, Bernard, Golz and Knoll, aided in the building of the present knowledge of the sympathetic.

In 1860 DuBois-Reymond inferred that migraine was due to the influence of the cervical part of the sympathetic, i. e., it produced a kind of tetanic contraction of the vessels, showing the influence of the sympathetic over vessels. He styled it Hemicrania sympathetic-tonica. Cruveilhier and Aran are credited with discovering muscular atrophy, but Charles Bell (1832) gives several cases. Bell places muscular atrophy in the domain of the sympathetic. Parry (1825) discovered a group of symptoms which we now call exophthalmic goiter (Graves or Basedow's disease) which many place in the field of the sympathetic nerve. The three great symptoms are (a) cardiac palpitation, (b) goiter and (c) finally exophthalmos. Basedow (1840) claimed to have first described the disease, but the priority of Graves is now universally known.

Angina Pectoris, described by Heberden in 1768, is placed by many in the sympathetic nerves, especially in the three cervical ganglia and the cardiac plexuses. Addison's disease is placed by some in the field of the sympathetic.

In 1783 Walter presented the best tables of the sympathetic nerves up to his day. It appears that Walter was the first who represented in his cuts the cervico-uterine ganglia, i. e., lateral ganglia of the uterus.

The above authors discuss in a very instructive method the various diseases of the sympathetic and attempt to establish as far as possible the physiologic, anatomic and path-

ologic limits of the domain of the sympathetic nerves. Especially interesting and valuable, though unfortunately limited, are the discussions of the abdominal parts of the sympathetic.

Eulenberg and Guttman discuss as belonging to the domain of the sympathetic system, the following diseases:

1. Functional disturbances, especially those due to irritation and paralysis.

2. Unilateral Hyperidrosis (perspiration).

3. Hemicrania (neuralgia).

4. Glaucoma (Neuro-retinitis, ophthalmia, neuro-paralytica).

5. Progressive Facial Hemiatrophy.

6. Progressive Muscular Atrophy.

7. Exophthalmic Goiter (Basedow's or Graves' disease).

8. Angina Pectoris (steno-cardia).

9. Addison's disease (bronzed skin).

10. Diabetes Mellitus.

11. Hyperesthesias of the sympathetic system.
    (a) Enteralgia, enterodynia, colic.
    (b) Neuralgia Celiaca.
    (c) Neuralgia hypergastrica.
    (d) Neuralgia spermatica.

12. Anesthesias of the sympathetic system (not well established).

13. Sympathetic paralysis and spasmodic affections of voluntary muscles. Reflex paralysis, diphtheritic paralysis, tabes dorsalis (locomotor ataxia, progressive).

The above thirteen classes of disease discussed as belonging to the domain of the sympathetic nerves have remained a more or less constant quantity with writers on the sympathetic nerve. However, some writers add, others subtract, while still others change the names of the above diseases. The subject is in a state of progress.

In 1867 Griesinger began investigations on the "Pathology of the sympathetic." Griesinger's enthusiasm stimulated two physicians, Dr. Paul Guttmann and Dr. Albert Eulenberg, to produce one of the best and most reliable books on the pathology of the sympathetic based on physi-

ologic grounds ever published. Griesinger's good work and enthusiasm were productive of practical results; for his remarkable words, that "our positive knowledge of the pathology of the sympathetic should be again collected by skilled hands" induced his scholars, Eulenberg and Guttmann, to study and write their prize book on the sympathetic nerves.

In 1876 a very learned and a very instructive essay appeared from the pen of Dr. Sigmund Mayer, entitled, "Die Peripherische Nerven Zellen und das sy npathetische Nerven System." Dr. Mayer was full five years engaged in the work in his microscopical laboratory and presented many interesting views and some of the most suggestive drawings of the nerves and cells. The essay represents many new views and vast labors.

In 1881 there appeared the "Fisk Fund Prize Essay," Rhode Island Medical Society—"The Sympathetic Nerve; its relation to diseases," by C. V. Chapin, M. D. This is a valuable essay as it gives many authorities and references to knowledge of this nerve. Dr. Chapin has sifted out the theoretical and practical knowledge of the nerve quite well. Chapin has but little deviation from the classification of the diseases which belong to the sympathetic of Eulenberg and Guttmann. An epitome of Chapin's book would be that is a record of opinions on the sympathetic nerve skillfully collected and arranged in a scholarly manner.

In 1885 Dr. W. H. Gaskell published some excellent labors on the sympathetic system of nerves. One of the best was entitled: "The structure, distribution and function of nerves which innervate the visceral and vascular systems." Dr. Gaskell noted some of the following points:

1. The visceral nerves issue from the central nervous system in definite sacral, thoracic and cervico-cranial regions.

2. From the above regions the visceral nerves pass out, through the ganglia, into the visceral system.

3. From the sacral region they pass out in a single stream to the ganglia of the collateral chain.

4. From the thoracic region they pass out in a double stream, one to the ganglia of the lateral chain, the other to the ganglia of the collateral chain.

5. From the upper cervical region they pass out in a single stream to the ganglia on the main stem of the vagus and glosso-pharyngeal nerves.

Gaskell's labors on the sympathetic are of far-reaching value and their utility has been recognized by being copied very generally and even in detail in the best modern works on physiology.

Rauber did some excellent work on the sympathetic, and his labor is recognized by Quain's latest edition borrowing one of his cuts.

In 1885 Dr. Edward Long Fox published a well written and very instructive book on "The Influence of the Sympathetic on Disease." This is the most comprehensive of late books on the sympathetic. He widens the influence of the sympathetic in the domain of disease beyond that laid down by Eulenberg and Guttmann. He includes insomnia, neurasthenia, pigmentation, myxedema and neuroses of the extremities—symmetrical gangrene. The writer can highly recommend Dr. Fox's book as instructive and valuable. Articles of merit and value on the sympathetic nerves have appeared with increasing frequency during the past ten years.

In 1877 Gubler described a morbid symptom of the peritoneum related to the sympathetic system. He called it peritonismus He included pain, meteorismus in various degrees, hiccough, vomiting, rapid pulse, cyanosis, lowering of the temperature, cerebral symptoms of great activity, depression of mental powers and decrease of amount of urine. The nerves of the heart are affected. This aggregate of symptoms Gubler designated by the word peritonismus. The abdominal surgeon only too frequently sees this clinical picture, but it is doubtful how much is gained by designating it as peritonismus.

We have thus finished a very limited and meager sketch of the sympathetic nerve. Vast numbers of worthy names and workers have not been mentioned for want of space. However, a few of the landmarks in the development of the knowledge of the sympathetic nerves have been noted, from Galen, its discoverer, to the present time. The sympathetic nerve has long been an unknown field as to facts. Our

knowledge of the nerve is still incomplete and will be for some time to come.

To the scholar and investigator the steps by which knowledge is gained are not only interesting but of value for further progress.

CHAPTER II.

A CLASSIFICATION OF DISEASES WHICH MAY BELONG IN THE DOMAIN OF THE SYMPATHETIC NERVES.

"A man's power is hedged in by necessity, which, by many experiments, he touches on every side, until he learns its art."—
Ralph Waldo Emerson.

We here present the classification of diseases considered to belong to the domain of the sympathetic nerve by various writers. The classification has no hard or fast lines, but we present it for the purpose of getting a general or bird's-eye view of the field of the sympathetic. The field of definite action, physiologic, anatomic or pathologic, of the cerebrospinal and sympathetic nerves, is not yet settled. The pathology of the sympathetic must rest on its physiologic paths. Physiology, with our present limited anatomical means of tracing nerve fibers, is surer than anatomy. It is difficult to make a satisfactory classification of diseases of the sympathetic, for a multitude of symptoms reasonably depending on the sympathetic nerves are encountered without our being able, by minute examination, to recognize the morbid process. Their chief manifestation is reflex action, referred disturbance.

Again, many sympathetic nerves, and especially ganglia, are found sclerosed, pigmented or possessed of increased connective tissue, at the autopsy, yet the patient left no records of physical complaints during life. Hence, it is difficult to trace back, in such cases, the interpretations of nature's physiologic experiment. Also, one is not always able to decide whether the pathologic findings at the autopsy are not secondary. No doubt there is a special pathology of the sympathetic nerve, or rather ganglia; but it may not be a recognized pathology. In normal and pathological states the sympathetic nerve is constantly affected by reflex

irritations. The pathology of the sympathetic is chiefly observed in the cervical and abdominal ganglia, and is characterized by vascularity, deposit of excessive connective tissue, pigmentation, atrophy, hypertrophy, selerosis, fatty infiltration, accumulation of microbes and leucocytes in the ganglia, amyloid or fatty degeneration. Sometimes the blood-vessels of the ganglia are found dilated and engorged with white blood corpuscles.

Classification of diseases which are certainly, or probably, connected with the sympathetic nervous system:

1. Functional disturbances.
   (a) Irritation (hyperesthesia).
   (b) Paralysis (anesthesia).
2. Hyperesthesia of the sympathetic (reflex irritation).
   (a) The abdominal brain (neuralgia celiaca).
   (b) The mesenteric plexus (enteralgia, enterodynia, colic).
   (c) Hypogastric plexus (neuralgia hypogastrica).
   (d) Gastric plexus (gastralgia, gastrodynia).
   (e) Spermatic or ovarian plexus(ovarian neuralgia).
   (f) Splenic plexus (splenic neuralgia).
   (g) Hepatic plexus (hepatic neuralgia).
   (h) Renal plexus (nephralgia).
   (i) Pelvic brain (cervico-uterine ganglia. Irritable uterus, Uterine neuralgia).
   (j) Aortic plexus.
   (k) Diaphragmatic plexus.
   (l) The cervical ganglia.
   (m) The cardiac ganglia (cardialgia; angina pectoris).
   (n) Trigeminus (facial neuralgia).
3. Anesthesia of the Sympathetic.
4. Paralysis or spasmodic affections of voluntary muscles.
   (a) Locomotar ataxia.
   (b) Epilepsy.
   (c) Diphtheritic paralysis.

5. Progressive muscular atrophy.
   Pseudo-muscular atrophy.
   Progressive facial hemiatrophy.
6. Visceral Neuroses Hysteria,
   Gastralgia,
   Gastrodynia,
   Insomnia.
   Pleurodynia.
   Peritonismus,
   Mastodynia.
7. Neurasthenia.
8. Pigmentation Spleen,
   Liver,
   Uterus,
   Adrenals.
9. Addison's disease (bronzed skin).
10. Hemicrania (headache).
11. Trigeminal neuralgia (facial neuralgia).
12. Exophthalmic goiter, Pavy's (1825), Graves' (1835), or Basedow's (1840), disease.
13. Angina pectoris or stenocardia (Heberden's disease, 1768).
14. Diabetes mellitus (hepatic neuralgia).
15. Diabetes insipidus (renal neuralgia).
16. Unilateral hyperidrosis (sweating).
17. Œdema.
18. Diarrhea.
19. Glaucoma.
20. Myxedema (sterodema).
21. Symmetrical gangrene of the extremities.
22. Pathologic changes in the sympathetic in other diseases—
    (a) In Syphilis.
    (b) In old age.
    (c) Leukemia.
    (d) Sunstroke.
    (e) Infectious diseases.
    (f) Cardiac diseases.
    (g) Malignant diseases.
    (h) Pigmentation.

The above table records diseases which are certainly or probably connected with the sympathetic nervous system. However, some of them are much more doubtfully connected than others.

We will here consider briefly the hyperesthesias (neuralgias) of the abdominal brain and its closely related plexuses of nerves. In regard to the functional disturbances, or reflex irritation, we have hyperesthesia or exalted irritability of the sensory nerves. The hyperesthetic nerve manifests itself first by pain, secondly by a reflex act on a motor apparatus. Hyperesthesia, or exalted irritability of the sympathetic nerves, is liable to manifest pain irregularly, periodically, paroxysmally, and yet retain some irritability during the intervals. The symptoms of hyperesthesia are generally uniform and persistent throughout the duration of the disease. Early life is very free from hyperesthesia of nerves and it does not endanger life. Anatomically, we know little of the characteristic changes in structure in hyperesthesia. The etiology of hyperesthesia is obscure, however malnutrition is perhaps a bottom factor. The reception of certain substances, as lead, will induce hyperesthesia or lead colic, neuralgia saturnina. Climate, sex and age play a role, as does anemia or plethora. Checking of secretions induces hyperesthesia, as does rheumatism, congestion. Hyperesthesia generally runs a chronic course, is periodic, seldom completely recovers, is often a forerunner of organic disease, is very persistent individually, and is doubtless accompanied by tonic spasm of vessels.

Hyperesthesia of the nerves of special sense is manifested by phantasms. One of the objects of this little volume is to attempt to show anatomically and physiologically how reflex irritation in one diseased viscus will unbalance the rest. For example, what gynecologist has not personally observed that a tender, irritable uterus will unbalance the other viscera (abdominal and thoracic) year after year? From some form of malnutrition or other morbid process the uterus has become chronically hyperesthetic, and the result is that the secretions and excretions, visceral rhythm

and circulation, are disturbed, malnutrition results, with the neurosis obtained from the nerve apparatus being bathed in waste-laden blood.

It is not easy, practical or even useful to discriminate between hyperesthesia and visceral neurosis, as one may blend into and become identical with the other. The active hyperesthesias of the great ganglia of the sympathetic system are characterized by an overpowering sense of prostration, a sense of impending dissolution, as if the center of life itself would be destroyed. This is the essential and common story of neurotic women. A blow on the pit of the stomach makes one stand with overwhelming awe of a coming danger, a sense of death-like anxiety and annihilation. These profound impressive sensations are characteristic of the sympathetic nerve. He who has once fainted need not be told of profound sensations. It may be here stated that the indefiniteness of the symptoms and findings in the sympathetic tracts have induced theoretical writers to offer placebos to the profession in the form of a profusion of terms, as gastralgia, gastrodynia, gastric neurosis, and gastric neuralgia, terms some of which mean nothing to the diagnostician, and are confusing to physicians.

From a careful study of visceral neuralgia it is evident that it is a secondary disease. It consists of a peculiar malnutrition of a sensitive nerve apparatus. The treatment of visceral neuralgia consists in improving nutrition, relieving present distress by harmless means and removing all depressing causes. The cause producing the reflex irritation of different viscera must be discovered and the appropriate remedial agent employed.

CHAPTER III.

GENERAL CONSIDERATIONS.

A little knowledge is a dangerous thing.—*Lord Bacon.*

The original investigations of the sympathetic nervous system, in both humans and animals, upon which this work is founded, was begun in 1887. These investigations have been carried on quite steadily since. The works of Fox, Chapin, Gaskell, Eulenberg & Guttmann, Patterson, Robert Lee, Lobstein, Snow-Beck, Rauber and Frankenhauser have been carefully studied. A number of physiologies, as well as some fifty anatomies, were searched. One hundred human cadavers have been dissected with reference to the sympathetic system and also among the lower animals, those of the rodents, solipeds, cow, calf, pig, dog, fish, bird, frog, rabbit, rat and sheep. The dissections have comprised in addition a considerable number of embryos, human and animal. The results of this work demonstrate that the ganglia of the sympathetic nerve are much larger in the lower animals than in man. That is, as the scale of animal life ascends, the sympathetic system proportionately decreases, while the cerebro-spinal system proportionately enlarges. In short, the higher the life the more dominant the cerebro-spinal system, and the lower the life the more dominant the sympathetic system.

In mammals there exist two brains of almost equal importance to the individual and also to the race One is the cranial brain, the instrument of mental progress and physical protection. The other is the abdominal brain, the instrument of nutrition and visceral rhythm. To the casual observer the cranial cerebrum seems to overshadow all other nervous centers. The anterior brain of mammals, situated in the skull, is so mani-

fest to the practitioner that it seems to do all the business of the nervous system. It is true that the knot of life is situated at the base of the cranial brain, and by one prick of a bodkin in the medulla life may be quickly extinguished. Yet a derangement of the abdominal brain destroys life as effectually, though not so quickly. A study of the abdominal brain brings to light views which are both important and practical. In the cranial brain resides the consciousness of right and wrong. Here is the seat of all progress, mental or moral, and in it lies the instinct to protect life and the fear of death. But in the abdomen there exists a brain of wonderful powers. It presides over organic life. Its great functions are two—nutrition and visceral rhythm. In this abdominal brain are repeated all the physiological and pathological manifestations of nutrition and rhythm of viscera. It controls nourishment and secretion. It initiates, sustains and prohibits rhythm. It receives sensations and transmits motion. It is an automatic nervous center. It is a physiological and anatomical brain. In short, it is a nervous ganglion; only a ganglion possesses rhythmical power.

The abdominal brain is situated around the root of the celiac axis and superior mesenteric artery. It lies just behind the stomach, consists of a blended meshwork of nervous ganglia, and is made up of the union of the splanchnics, the two pneumogastrics and the right phrenic.

There is a difference between the right and left abdominal brain. The left is more closely packed together. It is retort-shaped and chiefly consists of a large, solid ganglion. It is apparently an expansion of the lower end of the left splanchnic nerve and is larger than the right. The right half of the abdominal brain is more of a meshwork than the left. It is perforated with numerous apertures. In short, it is flatter and wider than its fellow. I am convinced that its flatness is due to the pressure of the inferior vena cava.

The abdominal brain really consists of two ganglia. These two ganglia are sometimes called semilunar, but I never saw one of such shape. The two ganglia are united by cords at the foot of the celiac axis and are known as

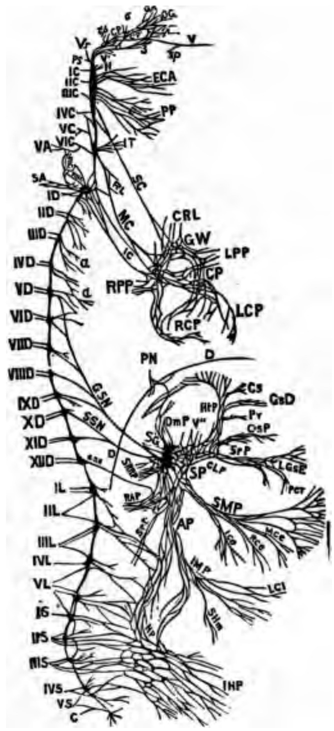

Figure 1.

A diagram of the sympathetic nerve (Flower) showing the lateral chain and the prevertebral plexuses.

the solar or epigastric plexus. This abdominal brain lying along the aorta just behind the stomach is a silent power in assimilation and rhythmical movements, unless some organ is deranged. Observation of the disturbance of visceral functions in women who were the subjects of pelvic disease led me to follow the work.

Disease of the viscera is apt to disturb the two great functions of the abdominal brain: nutrition and rhythm. The abdominal brain distributes its branches to all the vascular system—artery, vein and lymphatic. The branches of nerves will sometimes surround the artery like a sheath or pass along its parallel strands. In short, the branches of the sympathetic nerves are carried to all parts of the economy on the walls of the blood-vessels. The caliber of the blood-vessels, especially the smaller ones, is controlled by these fine strands of nerves. They may produce by their action the scarlet flush (capillary dilatation) of the cheek, or the marble paleness (capillary contraction) of fright. Several years ago, from experiments on the pregnant uterus of slaughtered cows, I became thoroughly convinced that the sympathetic nerve is the cause of rhythm, while the cerebro-spinal nerves prohibit rhythm. It is evident that the rhythmical waves in the fundus and body of the uterus are entirely due to the sympathetic, which almost alone supplies it. The sober stillness and non-rhythmical motion of the uterine neck is due to the excessive supply of spinal nerves. The order from the cranial brain for motion is active, direct and reflex subsiding after action. But the order from the abdominal brain is rhythmical, and the rhythmical movements play on all vessels and hollow organs, on the circulatory apparatus and the viscera.

The abdominal brain presides likewise over the glandular system. Here it holds the balance of power between normal blood-tissues and substances to be excreted. The abdominal brain controls secretion. The orders which it sends out to each gland, however, must be reorganized in each separate viscus, i. e., in the periphery of the nerves. The orders to the liver are manifest in the products of bile, glycogen

and urea. The forces sent to the digestive tract from the abdominal brain are obvious from the secretion of the digestive fluids, from the mouth to the rectum. The sympathetic system holds the glandular system as a unit, e. g., when the ovarian gland is injured or removed, inflammation may arise in the parotid gland. And mumps and parotitis may be accompanied by orchitis. The rhythm of glands, such as the liver and spleen, is possible from their elastic capsules. The orders from the abdominal brain to the digestive glands may become so violent that Auerbach's plexus throws the muscular wall of the gut into rigid contraction, and Meissner's plexus may secrete so rapidly that an active diarrhea may arise in a few minutes. It has been observed that herds of cattle on a ship have been attacked with diarrhea five minutes after the boat was put in motion. The abdominal brain was suddenly disturbed. The sweat-glands may be irritated so violently that the entire body becomes suddenly bathed in perspiration. Such execution may be done by inhibiting the sweat-centers.

Excessive or deficient gland secretion, then, depends on the abdominal brain and its principal machines. The gynecologist sees wonderful rhythmical movement in the generative apparatus, and he must refer this to the orders of the abdominal brain. The tubes and ovaries pass through rhythmical circles due to nervous bulbs situated in their walls. I named and wrote of these as "automatic menstrual ganglia," seven years ago. The ganglia of the tubes and uterus which cause the monthly rhythm are entitled to due respect, as well as the peripheral digestive and cardiac ganglia. Again, there is a machine called the vaso-motor center, which distributes itself in the medulla and along the spinal cord. If the abdominal brain is disturbed the vaso-motor center becomes deranged and the skin will be waxy pale or scarlet red. Under this category come the cold, white hands and feet of women, and the flushes and flashes at the menopause. In patients I have seen the neck and face show variation of color like that in a revolving electric light. The wave of redness will gradually pass over one side of the face and neck, and as it slowly disappears (2 to 4 minutes), the pale-

ness which follows is of a marble whiteness. Then the other side of the face shows that its capillaries go through a slow rhythm of dilatation and contraction. In ten minutes all the rhythm is over and the nervous, pale face again appears.

Uterine hemorrrhage from a myoma is reflex and accomplished by the sympathetic system. The bleeding is due to loss of tone in the vessels of the endometritum. The irritation starts in the mucous membrane of the uterus and passes up to the abdominal brain, where the force is reorganized and sent to the vaso-motor centers of the medulla and cord. Now, a continuous irritation soon disarranges a center and the vaso-motors sooner or later lose the power to control the blood vessels of the endometrium and become deficient in tone. It may be frequently observed that in a myomatous condition the tone of the vessels in the endometrium is restored and the bleeding ceases for a time, only to be renewed on exhausting irritation. Hence, we consider hemorrhage from a myomatous uterus as reflex. It consists in irritation followed, through reflex action, by vaso-motor paralysis, which harbors congestion. We note, then, that the abdominal brain presides over significant organs in man. It controls the forces which hold man's body intact. It has a very subtle way of enforcing chemistry to subserve its ends.

A general summary of the abdominal brain is that (a) it presides over nutrition; (b) it controls circulation; (c) it controls gland secretion; (d) it presides over the organs of generation; (e) it influences in a dominant, though not an absolute, control its peripheral visceral automatic ganglia.

Each of the above will again be discussed.

The ideal nervous system is: (1) a ganglion cell; (2) a conducting cord; (3) a periphery; the sympathetic nervous system possesses all three in an eminent degree. The abdominal brain represents the central ganglion cell. Its thousands of distributing and communicating fibers represent the conducting cord. The various ganglionic machines located in each viscus represent the periphery.

In regard to the independence of the sympathetic nerve we wish to say that it is not entirely independent in action,

but it may be insisted that it has a certain amount of independence which is very manifest in rhythmical motion. The dependence and independence of the (a) cerebro-spinal axis; (b) the abdominal brain and (c) the automatic visceral ganglia may be illustrated by (1) the federal government; (2) the state government and (3) the city or county government.

The cerebro-spinal axis is the federal government endowed with the chief rule of the animal. It is the central power and all others must submit to it. It is, moreover, to a large extent, under the will as far as motion is concerned.

The abdominal brain is the state government. In fact it exercises many functions almost entirely independent. The abdominal brain sends out its physiologic orders to all the visceral ganglia. If healthy, all obey, but disturbing pathology causes some to stop, or act irregularly.

The (automatic) visceral ganglia situated in each organ represent the county or city government. The city, or county, government is free from neither state nor federal government, but still it has normal independence which it freely exercises. The same views may be illustrated by society and labor in general where division of labor exists, and where certain sections exercise almost independent rights. Thus the sympathetic nervous system may be considered to be independent to a certain degree.

After a large number of dissections on man and animals, I find that the ganglionic system of the female is larger and more marked. Females seem to have more distinct ganglia and more marked conducting cords. I have not investigated the periphery sufficiently so far to render any opinion. I have found the abdominal brain and ganglia relatively larger in animals than in man. The abdominal brain is very large in the dog, in proportion to his cranial brain. Man's cranial brain has grown relatively faster than his abdominal brain, and I think man suffers more from malnutrition than do the animals, so that he pays dearly for his superior cranial brain power. Besides it appears that man's abdominal brain (and superior cervical ganglion) is

very liable to deteriorate with age. Disease is very apt to arise in the above ganglia after 40 years of age. Perhaps no animal suffers so much from indigestion as man and so far as I know he has not only the smallest abdominal brain, but it is attacked the most severely with disease. The latest researches would seem to claim that the sympathetic nervous system originates by sprouting from the ganglia on the posterior roots of the spinal nerves. Some believe that the sympathetic nerve originated from the adrenal.

Some points relative to the sympathetic nerve and the supra-renal capsules are quite obscure. The distribution of the sympathetic nerve is peculiar. It consists of three great parts.

1. There exists a double lateral chain of ganglia lying on each side of the vertebral column and extending from the skull to the coccyx. The ganglia correspond generally in number, to the vertebræ, except in the neck, where the seven are blended into three. The ganglia, no doubt, represent the original segmentation of the body. Now, the lateral chain of sympathetic ganglia is connected with all the cranial nerves, and with the spinal nerves. It is strongly connected with the latter by two well-developed cords, and lies close to each side of the vertebral column, out of the way of pressure. A notable feature in regard to the lateral chain of the sympathetic is that it is very intimately connected with the cranial nerves, and also very intimately connected with the sacral nerves. In other words it blends at the ends very closely with spinal and cranial nerves, but is less intimately associated in the middle with the spinal nerves. The best way to demonstrate the sympathetic system in the human is to place an embryo or fetus in alcohol and then open the chest and abdominal cavities, when the chain can be easily observed through the pleura and peritoneum. The sympathetic nervous system is relatively much larger in the fetus than in the adult. In a dog just killed one can see the sympathetic nerves through the pleura very easily and they can be observed also through the peritoneum.

2. The second part of the sympathetic consists of four

great plexuses of nerves, situated anterior to the vertebræ, called revertible plexuses. One is the pharyngeal, situated around the larynx. Another is the cardiac and pulmonary plexus. A third is the solar or epigastric plexus, situated around the celiac axis, and superior mesenteric artery. The ganglia in the solar plexus are what I am calling the abdominal brain. A fourth plexus lies in the pelvis, and is distributed to the generative organs and rectum.

3. The third part of the sympathetic consists of the peculiar mechanism at the ends of the nerves situated in each viscus. It is termed the peripheral apparatus. In a diagnostic sense the peripheral apparatus is the most important to the physician, as he can often only make his diagnosis by the manifestation of the disturbances of the periphery of a nerve in a viscus; e. g., in dyspepsia Auerbach's and Meissner's plexus may be wrong. In jaundice the automatic hepatic plexus may be wrong, and bile, glycogen and urea fail in proper quantity. It is well to remember that there are three more or less distinct splanchnics distributed in the viscera.

The splanchnics are the inhibitory nerves of viscera, e. g., of sensation, motion and vaso-motor action. 1. There are the cervical splanchnics, which arise in the cord from the first cervical to the fourth dorsal. These splanchnic nerves mainly reach the viscera (heart, stomach, etc.), by traveling up the cervical portion of the spinal accessory and then passing down the vagus (especially the right). 2. The second splanchnics arise in the cord from the second dorsal to the second lumbar and pass through the rami communicantes to the three or four abdominal splanchnics, whence they pass to the abdominal brain. These govern the vascular area of the intestines, etc. 3. There is also a third set of these nerves, called the pelvic splanchnics. They pass out from the cord by way of the second and third sacral nerves and do not enter the lateral chain, but pass on to the hypogastric and thus supply the genitals. From the origin of these three great splanchnics (cervical, abdominal and pelvic), it is clear why irritation or a blister on the lower part of the back of the neck is so effective in dispelling visceral dis-

turbances. The blister inhibits the vaso-motor centers and thus soon rights the vascular disturbances in the viscera.

The three splanchnics control the vaso-motor region of the viscera. It may be considered that the sympathetic nerve is endowed with sensation and motion. But the sensation is dull in the sympathetic, and its motion is rhythmical. But the utility of the sympathetic in the animal economy is not fully settled. The reason is that experiments on this nerve are not perfectly decisive, and also because it is so intimately blended with the cerebro-spinal nerves. But some study has convinced me that it plays a large role in chronic or remote uterine disease, and that is what has called out this paper. The sympathetic nerve produces involuntary movements. It is called the ganglionic nerve, from its tendency to form ganglia, or knots along its course. In using the term, "abdominal brain," I mean to convey the idea that it is endowed with the high powers and phenomena of a great nervous center; that it can organize, multiply and diminish forces. The views which I wish to bring forward concern the periphery of the abdominal brain, or the mechanism found in each viscus. I mean by viscera those organs contained in the chest and abdomen.

During the investigation of the sympathetic I selected a spare female cadaver, about thirty years of age, amputated the thighs close to the body, and then placed it in full strength alcohol. For nearly two years I dissected on this cadaver, as I found time, and finally after tedious labor dissected out all the visible sympathetic nerves which lay on the dorsal region of both chest and abdomen, returning the cadaver to the alcohol when not using it. I then secured a skilled artist, who worked on the drawing of the sympathetic nerve about five weeks, sketching it as nearly according to nature as it was possible, and exactly life size. The most important portions of the nerve are represented in the cuts accompanying this work.

Before discussing other subjects I wish to make a few remarks on three exaggerated ganglia of the sympathetic nerve, viz: the cervical, the abdominal and the pelvic. It is easy to dissect out the cervical, and especially the large upper cervical, which is about one and one-half inches long.

It is very variable and appears to shrink a little with age, over 40. The middle cervical is often so small that it is difficult to expose. The lower cervical is often difficult to dissect and isolate on account of complicated relations, and also because it is so widely spread out, so fenestrated and because its parts vary so much. The abdominal brain is quite easy to isolate, especially in a fresh cadaver. The best way to dissect and expose it well, without mutilating the body badly, is to tear through the ligamentum gastro-colicum and pass to the celiac axis. Then, with a forceps, clear away the tissue just above the middle of the upper border of the pancreas, i. e., at the right and left of the celiac axis.

In searching for the abdominal brain it is best to strike for the entering great splanchnic nerve and then follow it to the side of each ganglion. On the left will be found a large retort-shaped solid ganglion of a pinkish gray color. On the right of the celiac axis is found a wide, flattened, much fenestrated ganglion. Both are well supplied with blood. The most difficult great ganglion to isolate and expose in a natural condition is the uterine ganglion or pelvic brain. It is very large, much fenestrated, quite flattened and richly attached to the second and third sacral (spinal) nerves. It is situated close to the neck of the uterus and sends numerous nerves to this organ and the bladder. It requires much interrupted leisure to isolate the pelvic brain and it is almost always a failure in fat subjects. The cause of this difficulty in isolating the pelvic brain lies in the fact that it is whiter than the other great ganglia and more like the surrounding connective tissue, in which it is intimately blended and imbedded; also because it is so much flattened out. Probably more disputes have arisen over the cervico-uterine ganglion than any other in the body. However, the cut of the pelvic brain, here presented, the author considers quite close to nature.

In each of the viscera are found small nervous ganglia scattered through the organ, or the nervous bulbs are gathered in distinct localities of the viscus, as in the heart or digestive tract. Now it may be understood that these little ganglia found in the organs have the power to maintain

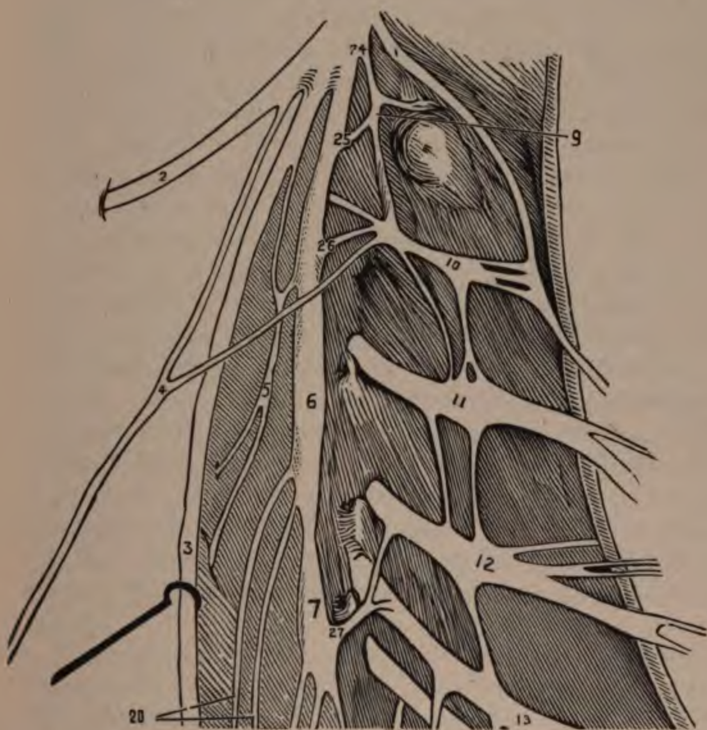

Figure 2.

(From author's life-size chart of the sympathetic nerve); 6, superior; and 7, inferior cervical ganglia; 9, 10, 11, 12, and 13, cervical nerves; 24, 25, 26, and 27, cervical rami communicantes; 3, vagus nerves; 20, superior cardiac nerves from superior cervical ganglion; 5, laryngeal nerve; 4, descendens noni; 2, hypoglossal nerve.

movements to some extent. These peripheral ganglia may be looked on as little brains which are capable of developing nerve force and communicating it to the organs without the aid of the cerebro-spinal axis. They can multiply or diminish nerve force, which is sent to a viscus where they exist. Diseases of any viscus or disturbance of its rhythm must be due to them or abnormal forces passing through them, arising from the abdominal brain. Again, the rhythm and function of a viscus are involuntary, i. e., beyond control of the will. They are automatic nerve centers placed in the viscus in order to isolate it from the control of man's mind. These little brains induce the viscera to perform their functions independent of the state of mind. They exclude the mind from speculating on the viscus so far as regards function. The will cannot induce the ganglia to do two years' work in one, or one year's work in two. The peripheral ganglia of every viscus assumes its own time of rhythm. The ganglia of each viscus rise to a maximum and sink to a minimum according to their own law of existence. They go through a rhythmical movement, a peculiar cycle. There are explosions of nervous energy from the ganglia during regular periods of time. For example, the heart ganglia thus explode a little oftener than once a second, while those of the tubes and uterus explode once a month.

We will consider the peripheral apparatus of the heart, lungs, uterus and tubes, liver, spleen, kidneys, bladder and digestive tract. A study of the ganglia in each organ will enable one to diagnose disease in the said viscus.

1. The peripheral ganglia have been well studied and some of the more important ganglia of the heart substance have received definite names. The little brains in the heart are called automatic cardiac ganglia. They are named the automatic centers of Remak, Bidder, Ludwig and Schmidt. These are simply some of the more important automatic motor centers of the heart. In many experiments on dogs I have repeatedly satisfied myself that the automatic cardiac ganglia are mainly aggregated in the auricles and auricular ventricular septum. Wherever the automatic motor centers are located in the heart anyone can satisfy himself that these

ganglia excite and maintain the rhythm of the heart. The frog's heart can be kept in rhythmical motion by stimulation in warm salt water for hours after it has been removed from the body. A few experiments on animals will soon convince one that the peripheral ganglia of the sympathetic nerve located in the heart are a very significant apparatus as regards the cardiac functions. The disturbance of the heart's rhythm by uterine disease is what we will attempt to demonstrate in its appropriate place. The most striking peripheral apparatus of the sympathetic nerve is found in the heart. Its rhythm is so perfect, its cycle is so apparent and its explosion so manifest, that men sought its origin outside the cerebrum. The dominating influences of the automatic motor-centers on the heart are shown by the idea that in living fetuses, without a brain or spinal cord, the heart keeps up its rhythmic beat. In such fetuses the heart ganglia are well developed. One-half of the spinal cord has been removed in pigeons without disturbing the cardiac beat. Besides, the inferior cervical ganglion has very intimate connections with the great ganglion of Wrisberg.

2. The peripheral apparatus of the sympathetic nerve is very prominent in the digestive tract. The digestive tract consists of a muscular and a glandular apparatus. The muscular apparatus of the digestive tract consists of a longitudinal and a circular layer, and between these two muscular layers lies a system of nervous ganglia known as Auerbach's plexus. Auerbach's plexus is the peripheral apparatus that induces muscular movements in the gastro-intestinal passage. These little brains lying between the muscular layers are the cause of intestinal peristalsis or vermicular movements of the bowels. Undue stimulation of Auerbach's plexus causes colic, and insufficient stimulation is followed by constipation—a muscular paresis. An insufficient activity in Auerbach's plexus induces a kind of ileus paralyticus.

Just under the mucous membrane of the digestive tract there lies a still more delicate system of nerve ganglia called Meissner's plexus. Dr. D. D. Bishop, histologist to Rush Medical College, has prepared for me very beautiful speci-

mens of Auerbach's and Meissner's plexuses from dogs, by the gold-staining method. This plexus presides over the production of the secretions of the gastro-intestinal passage. The office of these little brains is really to control glandular secretion. They induce the secretion of digestive fluids. They assume the office of regulating the proper amount of fluids to digest the various foods, which office requires a nice balance. Hence, Auerbach's and Meissner's plexuses are the distinct and marked peripheral apparatuses of the digestive tract. Now these little brains situated in the gut-wall have an action quite independent of the cerebro-spinal axis. I have often chloroformed a dog and then watched the intestines perform their peristalsis after being tapped. If the dog is kept in a warm room, the gut will go through its peristaltic motion for an hour and a half after death. The peristalsis will be strong and very marked. Half an hour after death it will be so strong that the circular muscles of the gut will contract so as to look like a pale white cord, or band, around the gut. Auerbach's and Meissner's plexuses are what induce rhythm in the bowel. The presence of food of course gives the occasion for rhythm. Hence, we must look to the peripheral nervous apparatus of the digestive tract when colic, indigestion, diarrhea and constipation arise, for these little brains induce motion and secretion in the bowel. Of course they are under the physiological and anatomical orders of the abdominal brain—a higher central organism. The pathology of Meissner's plexus is shown in (a) deficient secretion, (b) excessive secretion and (c) disproportionate secretion; that of Auerbach's, in paralysis or contraction (colic).

3. The peripheral nervous apparatus of the generative organs is located along the Fallopian tubes and uterus. I named these seven years ago "automatic menstrual ganglia." These ganglia can easily be demonstrated by taking a fresh tube from the abdomen and putting it in warm salt water. If the tube is teased and stimulated it will go through a peristaltic motion for half an hour. It is easy to observe the longitudinal muscles of the tube elongate and contract, still easier to watch the circular muscles of the tube con-

tract and dilate. I have done this experiment often enough in men and animals to be thoroughly satisfied of the existence of the peripheral ganglia in the tubes and uterus.

The automatic menstrual ganglia have a monthly rhythm. They rise to the maximum and sink to the minimum every four weeks. The ganglia exist in the uterus, and I have found the proof of this to be most easily demonstrated in the pregnant uterus of slaughtered cows, where my attention was first directed to the matter. Anyone can witness it in a slaughter house. When a well advanced pregnant uterus of a cow is cut off between the body and the internal os, a most wonderful rhythmic phenomenon is observed. The cow may have been dead half an hour, yet the two muscular layers of the uterus can be seen to act separately and vigorously. One time the circular muscles will contract vigorously and then the longitudinal muscular fibers will contract with equal vigor. Then, again, both the layers will work harmoniously together. The irregular action of the muscular layer is due to the irregular traumatic stimulus applied to the uterus. The rhythmical motion applies only to the tubes and uterus. The neck of the uterus does not go through rhythmical motion, because it is highly supplied by sacral spinal nerves. The spinal nerves prohibit rhythm.

The sympathetic nerves which supply the neck do try to make rhythm, but the spinal nerves to the neck predominate and sober down all rhythm. Hence, the predominating spinal nerve-supply holds the neck in sober, quiet subjection and allows no such wavy rhythm as goes on continually in the pregnant uterus. In this idea lies a great principle in gynecology. The neck of the uterus acts as its guard when pregnant. The waves of its rhythm may dash and sport as they choose, yet the neck stands on sober guard and permits no expulsion of the contents. The neck is never prepared for an abortion, but stands like an unmoved sentinel, so that no storm-waves of the uterus can drive out its contents or allow foreign invasion. The offices of neck and uterus are quite different. The neck has a different blood supply, a different nerve supply, a different muscular supply, and a distinct mucous membrane. It keeps out for-

eigners and prevents deserters. The nerve supply of the ovary is mainly from the ovarian sympathetic, but as I have so far been unable to determine the rhythm of ovulation, I will investigate that later. Suffice it to say that menstruation and ovulation, so far as I have studied, are different processes and hence will have a different rhythm. The menstrual rhythm is a matter belonging entirely to the monthly movements of the tubes and uterus. Menstruation might be called tubal motion or the rhythmic effect of the action of the automatic menstrual ganglia. The menstrual rhythm is an occasional process of the uterus and tubes, but ovulation is a constant process of the ovaries, whose distinct rhythm is yet to be determined. So far I have been utterly unable to determine the age and duration of the life of a Graaffian follicle, for I have seen ovulation in unborn babes and in women of 70. I have examined pigs, cows and sheep and found that all ovulated before birth. Ovulation continues from before birth until the ovarian tissue is worn out.

I assume, then, that the peripheral nerve apparatus in the organs of generation is a distinct affair, which I designated seven years ago as the "automatic menstrual ganglia." Its mechanism is such as to subserve the function of reproduction through a peculiar rhythm. The monthly rhythm in pregnancy is held in abeyance on account of the direction of energy to fetal nutrition. The derangement of the function of the automatic menstrual ganglia will engage our attention later. Any disturbance in these ganglia gives us a clue to the diagnosis of the disease.

We will term the small nerve bulbs situated in the walls of the bladder the automatic vesicular ganglia. The peripheral nervous apparatus located in the bladder is markedly sympathetic, and hence will, like other viscera, have its rhythm. The rhythm of the bladder is its contraction and dilatation. It has a diastole and systole. Its rhythm is to some extent lost sight of, because the diastole is so much longer than the systole. It requires hours for the diastole to complete itself, while the systole may be completed in a few minutes or less. But the rhythm of other viscera, as the heart, is not dissimilar. The heart has a diastole and a

systole, and the diastole of the ventricle is two-tenths of a second longer than the systole. The diastolic wave of the heart is the time when the heart gets its rest—physiologically and anatomically. The bladder has just as much rhythm as the heart, only it is not so strikingly manifested. The bladder gets an effectual rest during its long diastole. By careful dissection of a goodly number of bodies it can be clearly seen that the third sacral nerve of each side sends quite large branches to the bladder. The fourth sacral nerve also sends branches to the bladder. Under such circumstances the bladder is highly supplied with spinal sacral nerves, which would sober down the rhythm and prevent it as much as possible. The sacral spinal nerves distributed to the bladder go mainly to the neck, while the sympathetic mainly supply the fundus—the rhythmical portion.

This rhythm is easily demonstrated by taking the bladder from an ox and filling it with fluid. The contraction of its muscular wall will soon change the shape and gradually expel its contents. The neck of the bladder is more supplied with sacral spinal nerves than the body. In short, the great nerve center of the bladder is in the trigone. Hence, in pregnancy the disturbance in the bladder is due to the uterus dragging on the neck of the bladder where its sensitive (spinal) nerves exist. The female bladder is capable of retaining urine longer than the male bladder, as the neck of the former is not so fixed and hence is not dragged on as much when filling. The neck of the male bladder is fixed with the prostate, and when filled drags more or less on a fixed neck and so irritates the attending nerves. The peripheral ganglia of the bladder are mainly distributed to the fundus and body. The diastole of the bladder during sleep is prolonged on account of the quietude of the sympathetic. The peripheral ganglia in the bladder, the automatic vesical ganglia, have not received much study so far.

4. The peripheral nervous apparatus of the lung I have not especially investigated. That the lungs have an established rhythm is plain, which no doubt is maintained by the ganglia situated in their substance. The peripheral ganglia should be called the automatic pulmonary ganglia. No doubt there also exists a conjoined cerebro-spinal center.

5. The peripheral nervous apparatus of the liver may not at first sight seem manifest. But the liver is enormously supplied by the sympathetic, the nerve of rhythm. The liver is a gland, and one who has made a study of the peripheral ends of the sympathetic will have noticed that where it ends in muscular organs the ganglia are large and manifest. But when it ends in glands it forms a fine and delicate plexus of nerves. In the liver the ganglia are less apparent than the plexus which follows the fine vessels all through the liver. The caliber of these small vessels is subject to dilatation and contraction—rhythm. Every visceral organ during activity is in a state of vascular congestion—a condition of turgescence or enlargement. The surrounding of each viscus in the abdomen is such that it can be rapidly enlarged during its functional activity, and it returns to normal without loss of integrity. Now, the rhythm of the liver consists of its enlargement during functional activity and its return to normal during rest. The rhythm of the liver is made possible by (a) the elasticity of the peritoneum which surrounds it; (b), by its surrounding elastic capsule; (c), by the elastic tissue in Glisson's capsule which surrounds the vessels all through the liver, and (d), by the dilatability of the blood-vessels.

Hence, the liver gland is capable of enlargement and contraction—rhythm—from the possession of elastic tissue, and by engorgement. When the liver becomes employed, it becomes turgescent, or engorged, and its envelopes or capsules expand from elastic properties. When the liver goes through its active rhythm its vascular excitement attracts large quantities of fluid, from which it makes bile, glycogen and urea, and the liver then returns to its normal by the elastic capsule forcing the newly-formed products out through the tubules to be employed in digestion. The liver in its quiet, reduced form gets self-repair. Thus the liver goes through its rhythm of enlargement (functional activity) and of contraction (self-repair, rest). The occasion of a rhythm of a liver is food in the digestive tract. It is the derangement of the rhythm of the liver by uterine disease which we will call attention to later. The derangement

of the liver rhythm will change the three great functions of the gland, which are to make bile, glycogen and urea. The derangement is brought about by disturbing the equilibrium of the abdominal brain. We will term the peripheral nerve apparatus in the liver the automatic hepatic ganglia. The derangement of these is manifested by (a) a deficient secretion (bile, glycogen and urea); (b) excessive secretion, and (c) by disproportionate secretion, especially the last.

6. The spleen has a peripheral nervous apparatus which enables it to do its duty in a rhythmic wave. In the case of the spleen the elastic capsule, to which is added involuntary muscular fibers, enables the organ to enlarge during functional activity and then to be reduced by elastic pressure to its normal size. Engorgement and elasticity are the two elements which aid to complete the rhythm of the spleen.

Vascular excitement, with dilations and turgescence, characterize the functional activity and enlargement of the spleen. Its capsule expands. Contraction of the elastic capsule and muscle fiber in it characterizes the reduction of the spleen. Its rhythm is made up of its active enlargement and its passive reduction. In the maximum stage of the rhythm, the spleen performs its functions, and in the minimum stage it gets its rest and self-repair. A curious feature is added to the spleen in the form of a tortuous artery. The object of this spiral artery must be to withstand sudden motion or enlargement, for when the spleen is large the artery is just as crooked as it is in the enlarged uterus. But it may be that the tortuous artery allows a greater flow of blood. Hence, the spleen performs its rhythm from the peripheral nervous apparatus situated in its substance. The occasion of its rhythm must be the same as that of the stomach and liver—fresh food. We will term this nervous apparatus the automatic splenic ganglia.

7. The same reasoning applies to the rhythmic functions of the pancreas and kidney, and also, probably, to the ovary. They come under the law of vascular engorgement and elastic capsule, which enable the automatic peripheral ganglia to produce and sustain a rhythm. We thus have the automatic renal, and also the automatic pancreatic, ganglia.

1. We have tried to establish the view that the abdominal brain is the great nerve center of the abdominal viscera and perhaps of the thoracic viscera. 2. That it is the cause of visceral rhythm. 3. That each viscus has its own automatic peripheral ganglia or plexuses in the organ. 4. That the duration of the rhythm of each viscus is determined by the mechanism of the automatic ganglia situated in the organ.

Having planted our orchard we will examine its fruits. We now come to the application of these views to the subject of disease. Disease of any of the viscera will very often be preceded by some derangement of their rhythm. The two great factors in visceral diseases, so far as regards the sympathetic nerve, are (1) impaired nutrition, and (2) reflex action, referred pain or disturbance. An important central point around which much of the abdominal sympathetic turns is the female generative organs. They are the one cog in the wheel which makes the watch keep defective time.

The pathology of the sympathetic nerve is not so distinctly settled as that of the cerebro-spinal. 1. The most significant pathology of the sympathetic is reflex irritation, referred disturbance. 2. Pigmentation and sclerosis. The origin of the pigmentation is primarily in the spleen and liver. Pregnancies, menstruation (periodic congestion), fever (malarial), etc., etc., are accompanied by pigmentation. This may be due to a diseased state of the blood. It is more frequently due to reflex irritation from the distant organs. Some consider violent emotion as a cause of pigmentation, but it is likely that it refers back to some unrecognized lesion. 3. The third kind of pathology of the sympathetic would be secondary lesions to those of the cerebro-spinal system. 4. The fourth would be recognized and non-recognized lesions of the sympathetic. I have not space here to discuss these interesting and wide pathological fields, but simply mention them.

Disturbances in the Digestive Tract from Uterine Changes.—In this case we have immediate and remote troubles as regards time. The chronic uterine disease will produce remote malnutrition and remote reflex changes. In

these cases I mean diseases of the entire, or part of the, generative apparatus—vulva, vagina, especially the uterus, tubes and ovaries. Take, for example, a case where the digestive tract is deranged on account of pregnancy. In the first place the vomiting arises from the dragging of the neck of the uterus on the neck of the bladder. This dragging or pressure on the neck of the bladder disturbs the spinal and sympathetic nerves massed there. The irritation is carried up the hypogastric plexus to the abdominal brain. When the irritation arrives at the abdominal brain the forces are reorganized and sent out on the various nerve plexuses which radiate from this nerve center. If the force is emitted along the gastric plexus, which is liable from its large size, the stomach receiving sympathetic nerves from the three branches of the celiac axis, the stomach will suffer and vomiting be likely to occur. Now, in the troubles of the stomach resulting from reflex disturbances from the uterus by way of the hypogastric plexus, it may be considered that the stomach is affected in two distinct parts—(a) its muscular wall (Auerbach's plexus), (b) its glandular or secretory apparatus (Meissner's plexus). When the irritation from the generative organs travels up the hypogastric and ovarian plexuses to the abdominal brain it is then reorganized and emitted along the gastric plexus to the automatic gastric ganglia, known as Auerbach's plexus. It affects Auerbach's plexus first because it first meets it in the muscles—the result of irritation of Auerbach's plexus is irregular action of the muscles of the stomach—nausea or vomiting; when the irritation goes farther along the gastric plexus it meets Meissner's plexus, which lies just beneath the mucous membrane, and controls gastric secretion. If Meissner's plexus is considerably irritated it may cause too much or too little secretion of the fluids, or the fluids may be secreted in disproportionate quantities. The result will be indigestion and fermentation, causing the development of gases.

The reflex irritation from the uterus may be of such a nature that Auerbach's plexus may be insufficiently stimulated, causing paresis of stomach wall, or that Meissner's plexus is so little stimulated that it will not secrete suf-

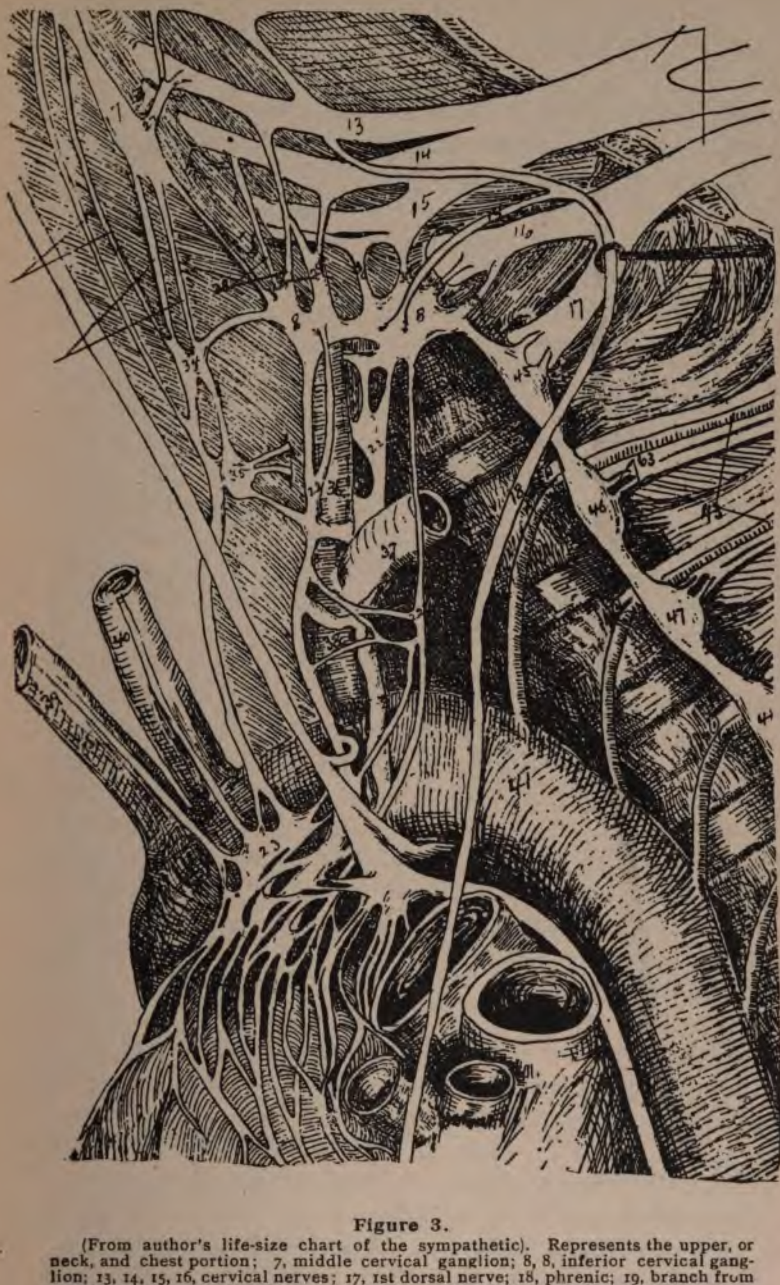

Figure 3.

(From author's life-size chart of the sympathetic). Represents the upper, or neck, and chest portion; 7, middle cervical ganglion; 8, 8, inferior cervical ganglion; 13, 14, 15, 16, cervical nerves; 17, 1st dorsal nerve; 18, phrenic; 19, branch from inferior cervical to phrenic; 20, 21, cardiac nerves from middle and superior cervical ganglia; 22, 22, and 22 cardiac nerves from inferior cervical ganglion; 23, Wrisberg's ganglion (of the heart); 24 to 33, cervical rami communicantes; 34 and 35, ganglia on sup. mid. and infer. cardiac nerves of the cervical ganglia; 36, vertebral artery; 37, left subclavian artery; 38, innominate artery; 39, right subclavian artery; 40, caroted artery; 41, aorta; 43, intercostal arteries; 45, 46, 47, dorsal lateral chain of ganglia; 63, communicantes.

ficient gastric fluids. But the track of the nervous irritation is definite from the generative organs, through the hypogastric plexus, to the abdominal brain, where it is reorganized and emitted to the various viscera. This is the interpretation of the old story that uterine disease creates stomach trouble and vice versa. By reference to a cut showing the pelvic brain, or cervico-uterine ganglion, one can see at once the extensive nerve supply which attends the uterus. It may be observed in cases of violent vomiting that digestion and nourishment are quite good. The reason must be that Auerbach's plexus is the main one affected (muscular), while Meissner's (glandular), the one which really digests the food is not much affected. In the case of chronic uterine disease the whole subject is plain and practical. Such patients have malnutrition for several years. In short, it is noticeable that a woman will apply for treatment of uterine disease some four years after the cervix has been lacerated. The illness was increasing all the time, the last part being more apparent. In stomach troubles from chronic disease of the generative organs, it appears that Meissner's plexus is affected the most, as such patients seldom vomit, but they do not digest their food, which is done by the gastric fluid secreted by the influence of Meissner's plexus on the cardiac and pyloric glands.

But I wish rather to note the effect of chronic disease of the generative organs on the intestines,which is the location of real digestion. The business part of the digestive tract is the small intestines—the jejunum and ileum. The small intestine is supplied by the superior mesenteric artery, and along this artery goes the great superior mesenteric plexus of nerves. What we will observe is the mechanism at the end of this superior mesenteric nerve, viz., Auerbach's plexus. This produces bowel peristalsis.

Take for instance a case of chronic endometritis, salpingitis or ovaritis of several years' duration. Disease of the female organs is a slow, continuous, progressive process. It is a kind of evolutionary process and generally should be read endometritis, plus metritis, plus endosalpingitis, plus ovaritis, plus as much peritonitis as the infection produces at the ends of the tubes. Because of this

slow, evolutionary progress of female disease the effect through this sympathetic nerve is of slow progress and gradual. The irritation from the generative organs will travel to the abdominal brain by way of the ovarian and hypogastric plexuses. It is a common observation that gases may develop in a few minutes so that fermentation is not the explanation of their origin. Some attempt to explain the origin of this intestinal gas by noting that it collects because the bowel muscle has lost its power to contract; but the gas develops too suddenly for this theory to fit. If the irritation from the uterine disease causes Meissner's plexus to secrete deficient fluids, indigestion and constipation arise. So reflex irritation from the generative organs, by way of the abdominal brain to the small intestine, can act in two ways. (1) It may so stimulate Auerbach's plexus in the gut wall as to produce colic, and so stimulate Meissner's plexus as to induce excessive secretion, deficient secretion or disproportionate secretion. The result here will be development of gases and diarrhea.

The abnormal stimulation of Auerbach's and Meissner's plexuses may result in deficient bowel peristalsis and secretion which ends in constipation. The final result of these is indigestion or malnutrition. Hence, chronic uterine disease creates its disasters on the system really by malnutrition. It disturbs the normal visceral rhythm. Malnutrition is manifest in pregnancy, in perceptible disease of the generative organs, and at the menopause. The explanation lies in the abnormal irritation of the nerves in the generative organs, which is reflected through the abdominal brain to the digestive tract. I have never heard or read of the method herein used to explain the action of the abdominal brain on the digestive tract, but I think it is a practical explanation. These views explain why animals or man lose control of the bowels under fright. The violent forces emitted from the abdominal brain induce excessive activity of Auerbach's plexus (colic) and Meissner's plexus (secretion) and a sudden diarrhea results in the animal. In other words, under high emotional influences the animal's rectal sphincters are unable to resist the violent bowel peristalsis.

Peristalsis is stronger than the orificial sphincters. Involuntary defecation is common among children and animals from fright. In older animals the cranial brain assumes more influence over the abdominal brain, i. e., it sobers down its violent and irregular rhythm. Chronic disease of the generative organs creates malnutrition in the digestive tract by disturbing its normal functional rhythm and by reflecting irregular rhythms into the digestive tract during its times of rest and repose. It does not matter what the disease of the generative organs is, so that irritation arises and is reflected to the abdominal brain. Inflammation, tumors or the local manifestations of the menopause, will act similarly, according to the degree of irritation. The subject may be considered in the following short summary:

The reflex irritation of the abdominal brain will cause Meissner's plexus to secrete (a) too much secretion (diarrhea), (b) too little secretion (constipation), or (c) disproportionate secretion (fermentation). The same thing will occur in any secondary organ, i. e., too much, too little or disproportionate secretion. Now, I will point out a matter which long puzzled me, viz., a woman who has a lacerated cervix will go through various pathological stages for some five years and end as a confirmed neurotic. I have observed it for years, and the order of occurrences is as follows:

1. The first stage is irritation. The irritation does not arise so much from the lacerated cervix as from the endometrium. The irritation keeps up for years.

2. The second stage is indigestion. The long continued irritation arising from the genitals and passing up to the abdominal brain, and being there reorganized and sent out on the plexuses of Meissner and Auerbach of the digestive tract, soon causes too much secretion, too little secretion, or disproportionate secretion, which results in indigestion.

3. The third stage is malnutrition. Long continued indigestion simply results in malnutrition. The reflex irritation goes on continually.

4. The fourth stage is anemia, resulting from the indigestion and malnutrition.

5. The fifth and last stage is neurosis, which is due to the nervous system having been bathed in waste-laden blood for years.

Hence, a patient with laceration of the cervix goes through five stages: 1, irritation; 2, indigestion; 3, malnutrition; 4, anemia; 5, neurosis.

We will now consider the liver as disturbed by disease of the generative organs, whether it be acute or chronic. We noted that the liver was highly supplied with sympathetic nerves; that it had a peripheral plexus in its substance. This we will style the automatic hepatic plexus. We noticed that the liver was induced to go through a rhythm by its automatic plexus, and that its rhythm was made possible by the elasticity of its capsules, the tissue which governs its expansion and contraction (rhythm) being elastic and contractile. Rhythm of the liver is made up of two distinct stages, a time of activity and a time of repose. Its stage of functional activity is when its capsules are expanding under the vascular excitement of turgescence, the products of cell-work, bile, glycogen and urea being secreted. Its stage of repose and self-repair is when its capsules are contracting, and the blood vessels are being depleted, the contracting capsule having partly forced the cell products (bile, glycogen and urea) into other regions and organs to accomplish their final object. By means of this rhythm the liver secures a stage of activity and a stage of rest.

It is plain why the liver suffers so badly among drinkers. The drinker has no regard for the time of rest of his liver, so he takes drinks especially at times when the liver is at rest. The irritating fluids pass by way of the portal vein into the quiet, resting liver and of course excite it to go through a rhythm at any time. Thus the drinker breaks his liver of the needed rest. The rhythm of the liver is disturbed and that calls up disease. It is precisely the same in diseases of the generative organs. Irritation starts from a diseased pelvis and travels up the ovarian and hypogastric plexuses to the abdominal brain. Hence, the irritation

is reorganized and emitted along the hepatic plexus. The automatic hepatic plexus is unduly and irregularly stimulated at times of activity and rest. The result is that the rhythmical function of the liver is deranged. The nice balance of its formation of bile, glycogen and urea is destroyed.

The diseased pelvic organs have no respect for liver rest and they send up their uncertain reflexes to the liver at unseemly times. Chronic disease of the pelvic organs will excite impulses which travel to the abdominal brain, which sends them along to the liver at such uncertain times that the liver never goes through its activity or rest, without more or less attempt to induce irregular rhythms. The final result is that the rhythm of the liver is disturbed and that the cell products of the liver are formed irregularly. Bile, glycogen and urea are formed excessively, deficiently or disproportionately and it all ends in malnutrition. The skin is yellow and sallow, the urinary products are abnormal. Diseases of the liver are manifest in pregnancy, in demonstrable pelvic diseases, and especially at the menopause. The anatomical nerve track followed by irritation from the generative organs to the abdominal brain, and thence to the liver, is plain, and the physiological results show the theory to be reasonable.

Right here we may say that liver disease and disease of the digestive tract are quite common at the menopause. The explanation of this is not difficult. During the thirty years of seed time and harvest of woman the abdominal brain emits its physiological orders to the automatic menstrual ganglia, situated in the uterus and tubes, to perform their rhythm of menstruation. Thirty years of rhythm in any organ will surely form a habit which it will require force to break. When the menopause arrives, which occurs suddenly, the old beaten paths of the hypogastric plexus, along which the menstrual orders for thirty years had been sent, are suddenly cut off. This sudden cutting off of old channels, by which forces were formerly emitted, is bound to make the latter accumulate in the central organ or abdominal brain. Now, these accumulated, unused energies must

have some outlet and they will go in the direction of least resistance. The great channels of easy outlet of pent-up forces in the abdominal brain appear to be the gastric and superior mesenteric plexuses, which supply the digestive tract, and the hepatic plexus. Hence, in the menopause the accumulated force in the abdominal brain is mainly spent on the digestive tract and liver. The accumulated energies go to these in an irregular manner and thus aid in disturbing their rhythm. The result is abnormal products in the liver (bile, glycogen and urea), and for the digestive tract indigestion (constipation or diarrhea).

The heart of woman does not escape the influence of the chief wheel of her existence. It has very manifest peripheral sympathetic ganglia and is largely under the control of the sympathetic nerve, as may be seen from its nice rhythm. Now, from each of the three cervical sympathetic ganglia on each side of the neck there goes a nerve to the heart (the heart also receives three nerves on each side from the pneumogastrics). When the pelvis contains diseased generative organs, the irritation arising there travels up the ovarian and hypogastric nerves to the abdominal brain.

From the abdominal brain two roads lead to the heart. One road is up through the great splanchnics to the cervical ganglia, and as these ganglia act as little brains, the force is here reorganized and sent directly to the heart. Of course all irritation comes irregularly and so aids in disturbing the heart's rhythm. But spinal or cranial nerves prohibit rhythm, so I think the main forces from the abdominal brain travel up the pneumogastrics to the fourth ventricle, and the irritation is then reflected directly to the heart. Irritation, especially that coming along a cranial nerve, quickly affects the rhythm in any viscus. In like manner irritation from diseased generative organs may reach the heart by first going to the abdominal brain and then through the splanchnics to the pneumogastrics to the heart.

The result is that the heart is disturbed in its rhythm. It palpitates, it beats irregularly. Who has not seen this in female diseases? I think palpitation is most manifest at the menopause. In pregnancy the heart prepares for the emer-

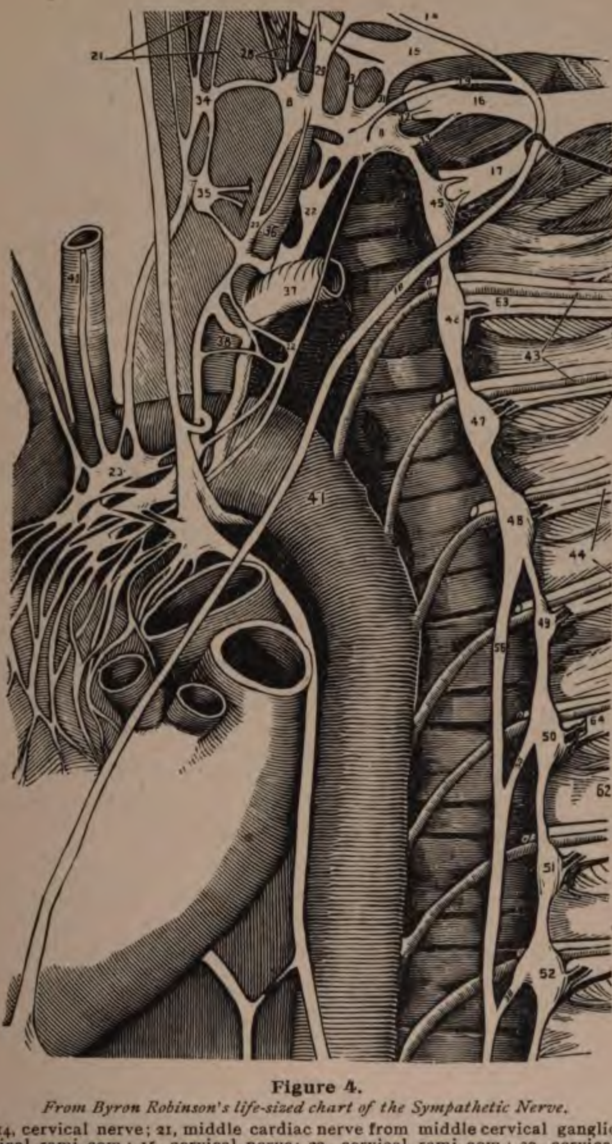

Figure 4.

From Byron Robinson's life-sized chart of the Sympathetic Nerve.

14, cervical nerve; 21, middle cardiac nerve from middle cervical ganglion; 28, cervical rami com.; 15, cervical nerve; 29, cervical rami com.; 30, cervical rami com ; 19, branch from inferior cervical ganglion to phren. nerve; 34, ganglion on superior middle and inferior cardiac nerve; 8-8, inferior cervical ganglion; 16, cervical nerve; 17, dorsal nerve; 35, ganglion on superior middle inferior cardiac nerve; 43, intercostal artery; 36, vertebral artery; 40, carotid artery; 58, splanchnic; 52, dorsal lateral chain of ganglia; 18, phrenic nerve; 37, left subclav. artery; 63 rami com.; 46, dorsal lateral chain of ganglia; 38, innom. artery; 2-2-2, inferior, cardiac nerve: 47, dorsal lateral chain of ganglia; 23, Wrisberg's ganglion; 41, aorta: 48, dorsal lateral chain of ganglia; 44, intercostal nerve; 49, dorsal lateral chain of ganglia; 56, splanchnic; 50, dorsal lateral chain of ganglia; 64, rami com.; 67, branch to stomach; 51, dorsal lateral chain of ganglia.

gency by thickening its walls and is generally no worse for undergoing the extra work incident to gestation. But let the heart meet a myoma, which is continually emitting irregular reflections to it, and disturbing its rhythm, and sooner or later it is weakened and degenerated. The heart rests and repairs itself during part of the rhythm, but irregular reflections from pelvic diseases do not allow it sufficient rest. Fatty degeneration or malnutrition results.

The heart palpitates at the menopause because the accumulated energies of the abdominal brain find an easy outlet through the splanchnics and pneumogastrics. The menopause often requires several years for its completion, so the abdominal brain can get accustomed to controlling and distributing the accumulated energies which were once expended in the menstrual rhythm. The trouble is that its accumulated but irregular energies are apt to dash pell mell over some single plexus to some single viscus and then disaster is sure to follow from inability to resist. If the accumulated energies were evenly distributed, but little visceral rhythm would be disturbed.

I know of no organ so manifestly affected in the menopause as the heart; perhaps for the very reason that the sympathetic nerves chiefly accompany the blood-vessels. Hence, when some portion of the sympathetic system is disturbed, it is apt to affect the nearest structures, which are those of the vascular apparatus, the chief portion of which is the heart.

The same kind of reasoning is applicable to the spleen. Diseased generative organs reflect their irritation to the abdominal brain and then to the spleen. Irritation always proceeds irregularly, and so it would disturb the rhythm of the spleen, and thus create malnutrition. The spleen goes through a rhythm just as do other viscera. The spleen is no doubt the chief organ concerned in pigmentation. Jastrowitz, of Russia, first taught that the spleen was concerned in deposit of pigment; for he found that by severing the nerves which pass to the spleen on its vessels, in dogs, irregular pigmentation followed. Every gynecologist knows

that pigmentation of the skin is common at the menopause, in pregnancy and at puberty, i. e., when the sympathetic nerves are more or less disturbed. Of course little doubt exists that the liver has something to do with the deposit of pigment, as may be noted in malaria, which exercises its brunt on the liver. Hence, the disturbed rhythm of the spleen in uterine disturbances manifests itself by pigmentary deposit.

In disease of the uterus it is quite easy to note that the rhythm of the bladder is disturbed. It is not because the fundus of the uterus rests on the fundus of the bladder, but because the automatic vesical plexus is irritated. The neck is dragged or pressed upon and the nervous mechanism suffers.

Similar explanations might be made relative to the lungs, kidneys, pancreas and ovaries; but I think sufficient has been said to show that each viscus has its automatic peripheral ganglia, that each viscus executes a rhythm, and that the diseased generative organs may disturb the rhythm of any viscus by reflex irritation through the abdominal brain.

The peripheral nerve supply to the genitals is vast, and no organ can raise such nerve storms as the generative. They are intimately and intensely connected with all nerve centers, but especially those of the sympathetic. How often does one see strong men faint from the simple introduction of the sound into the urethra? The vast peripheral nervous apparatus ending in the urethra is disturbed, and this nerve storm which sweeps up the hypogastric plexus spends sufficient power on the heart alone to cause faintness. Of course it spends a relatively large amount on every other viscus. Note how pale the man becomes. The storm dwells with equal force on the whole skin surface. Of all viscera the genitals are most intimately and closely connected with the nerve centers, both anatomic and physiologic, for the sexual instinct predominates in all races of mammals. From the very physiological and anatomic nature of the reproductive organs they demand a close and intimate nervous con-

nection with the great centers, and hence no storms affect adjacent and distant viscera like those arising in the extensive genital nerve periphery.

Cold Hands and Feet in Women.—Every gynecologist has witnessed cold extremities in women with diseased generative organs. In this case we must look to the great dominating vaso-motor center, situated in the medulla oblongata. Secondary vaso-motor centers also appear to exist along the main length of the spinal cord. The vaso-motor centers are reached (a) through the pneumogastrics, especially by irritation coming from the abdominal brain; (b) by the lateral chain of the sympathetic which is prone to emit its irritations along the brachial plexus, or the sacral plexus, or the lumbar plexus. No doubt the irritations are emitted along each intercostal nerve, but vaso-motor contractions are more manifest in the extremities. In vaso-motor contractions the skin is always most blanched at the extremities, as the hands or feet. When the generative organs are diseased, the irritation goes to the vaso-motor centers in the medulla and cord by two routes.

1. It goes up the ovarian and hypogastric plexuses of nerves to the abdominal brain. Then it is reorganized and sent up along the pneumogastrics to the dominating vaso-motor center in the medulla, whence it is reflected over the whole body, especially to the small vessels at the extremities, on which it is the most effective in blanching white the skin and cooling the hands and feet.

2. It can also go up the lateral chain from the coccyx, especially by way of the hypogastric plexus. I found in dissection of cadavers (especially female) that the lumbar lateral chain of ganglia were strongly and liberally connected with the hypogastric plexus by large, thick nerves. Hence, the irritation from the generative organs will go up the hypogastric plexus and be deflected to the lumbar lateral chain and go onward both to the spinal cord and medulla. Then the vaso-motor centers in the medulla and cord reflect their irritations to the whole body, but especially to the extremities. So that irritations from the generative organs reach the vaso-motor centers in the medulla and spinal cord by

two routes: (a) by the pneumogastrics from the abdominal brain, and (b) by the lateral chain of ganglia. The result after following both routes is similar, viz., paling and cooling of the skin, especially of the extremities. Physiologists have proved that the most powerful vaso-motor constrictions exist in the hands and feet. The conclusions are the same as those discussed in the viscera. The end of the whole matter is malnutrition. For the arterioles and capillaries have been disturbed in their rhythm. The vascular rhythm exists, but it has not been determined as to time.

But when a large area of skin (tissue) is depleted of nourishing blood for a considerable time, malnutrition is sure to result. The cause and effect in the woman are definite. The irritation starts in the generative organs and travels by definite routes to end in influencing the sympathetic nerves to contract the vessels which they surround. I have such women in my practice continually. Vaso-motor effects on the extremities are generally a remote disturbance of chronic pelvic disease. The irritation of almost any viscus which will effectually disturb the abdominal brain is liable to cause vaso-motor constrictions. It is mainly from the generative organs in the female. By carefully studying patients one can see the immediate and remote effects of pelvic disease. The immediate effect may be observed to be from the localized, tangible, gross pathology. It may be pressure troubles, septic troubles or otherwise. But the remote effect is through the sympathetic nerve, or rather through malnutrition. A slight, unnoticed irritable focus begins in the pelvis (it may be endometritis). Months and years go on. Irritations accumulate in the abdominal brain and may radiate out on all its various plexuses. Nutrition is insidiously impaired through the months and years, unbalanced reflexes gather in the abdominal brain, which, in turn, disturb the normal functional rhythm of viscera. Accumulated energies, begotten of long continued pelvic disease, are not controlled by the abdominal brain, but irregular, stormy forces are emitted over the plexuses to the viscera, which unbalances their rhythm and ruins their nutrition. The

woman with genital disease becomes an object of wretched despair and a miserable invalid. The days of her life are passed between pain and sadness. Our amateur operative gynecologist has forgotten that all her troubles started from a lacerated cervix or endometritis five years ago. He is sure to extirpate her ovaries, if he can, and lo! how disappointed he is if she does not get well in a month! Such a woman will not get well for at least a year. The only benefit of extirpating the appendages was that she was compelled to lie still for a month—a dear method of purchasing a few weeks' rest. The proper method to follow in this numerous class of women is to hunt for the old cause and remove it, and then gradually nourish the woman back to normal. Such women are called hysterical, but there is generally some pelvic pathology that precedes hysteria before the abdominal brain suffers derangement.

Space forbids any discussion as to the dependence or independence of the sympathetic nerve in regard to the cerebro-spinal system. Yet we may assert that the sympathetic is independent to a certain degree. Babies have been born at full term with no cerebro-spinal axis. The heart will beat some time after death. I have often noted the intestines performing peristalsis more than an hour after death. I have watched the uterus going through its rhythm in slaughtered cows an-hour-and-a-half after death. The independence of the sympathetic is seen in vaso-motor neuroses of the extremities. The tone of vessels is maintained by the sympathetic. The sympathetic controls secretion. If the brain and spinal cord of a frog are removed, his skin will show pigmentation. The viscera have involuntary movements and are out of will control. The viscera are excluded from the mental sphere. But, like the watch, which requires every cog and wheel to keep time, so the sympathetic needs the cerebro-spinal to maintain the balance of life.

A few general ideas of the sympathetic nerve may be of interest. The rhythm of the viscera, due to the abdominal brain, will, no doubt, adequately explain the axial rotation of abdominal tumors. The emptying and filling of hollow

viscera in their continual rhythm is apt to rotate adjacent tumors with narrow styles. Narrow pedicles are, of course, more apt to rotate than thick ones. It is a curious fact that when a woman possesses more than one tumor in the abdomen, there is more danger of axial rotation. A pregnant uterus or tumor doubles the danger of the twisting of the tumor on its axis. The axial rotation of a tumor is, no doubt, enhanced by the sudden emptying of the uterus, and its change of location at delivery. But the main point in the matter is visceral rhythm, e. g., of the intestines and bladder. It is estimated that 10 per cent. of abdominal tumors rotate on their axes. The reflexes of the abdominal brain and sympathetic ganglia are very numerous. A blow on the solar plexus causes syncope by reflex action on the heart. The vagus (right) compels the heart to beat soberly, and two-thirds of the right vagus goes also into the abdominal brain. But the cervical sympathetic rules the heart in its rapidity and regularity. The vomiting on the passage of gall-stones, or renal calculus, or that of pregnancy, shows the abdominal brain to be a great reflex center and place of reorganization of forces. Notice the changed pulse in peritonitis, and the tremendous collapse in intestinal perforation, due to disturbed circulation. Watch the shock after colotomy, due to trauma on the peritoneum. The peritoneum is mainly supplied by sympathetic nerves, so it acts through the solar plexus. It is easy to see how nerve storms shock the heart from peritoneal manipulation. I have noted depression of the heart. The peripheral arteries contract and the heart cannot drive the blood home. It is easily seen that in the abdominal brain and cervical sympathetic, the great regions of reflex action play a great role in neuroses and all emotional phenomena. When we feel fear or fright, the effect is noticeable in the solar plexus, which lies behind the stomach. Sorrow and sadness are, frequently, first felt in the abdominal brain. The good-hearted David said that he "yearned for the young man in his bowels." His is only a common experience that the abdominal brain plays a role in emotional and neurotic phenomena because of its capacity for reflex action.

CHAPTER IV.

THE INDEPENDENCE OF THE SYMPATHETIC NERVE.

'A want of individuality is the most dangerous sign in modern civilization."—*John Stuart Mill.*

It may aid in comprehending the structure and function of the sympathetic nerve, and in concluding discussion in regard to its independence, to arrange in short, concise propositions a number of observations which will show that the sympathetic nerve has a large degree of independence.

1. The independence of the sympathetic system is impressively shown in the distinct rhythmical action of the heart for some time after being removed from the body. This can be best demonstrated in the frog and turtle.

2. The peristaltic and vermicular motion of the intestines after death significantly point to the independence of the sympathetic nervous system. The intestines of a dog will continue in peristalsis for two hours after death if the room temperature be 100 degrees Fahrenheit.

3. The fetus has been born at or about term without a trace of brain or cord. This shows that nutrition, growth, secretion, absorption and circulation were conducted alone by the sympathetic—one of the strongest demonstrations of its independence.

4. Experiment has shown that nutrition (which means life's function) may be carried on after complete destruction of the cerebro-spinal centers.

5. Nourishment without the cerebro-spinal center would indicate that the arteries (blood-vessels) are under the control of the sympathetic system. Goltz goes so far as to say that the tone of the arteries is maintained by local centers situated in their own immediate vicinity.

6. The manifestations of blushing, local congestions and eruptions would tend to show that the blood acts reflexly on

the vessels, affecting the vaso-dilators or the vaso-constrictors. The white line (followed rapidly by a red one) on stroking the skin with the finger, as in scarlet fever, indicates that the vessels possess local nerve centers of control. The trauma produced on the vascular centers by stroking the skin first irritates the vaso-constrictors, and paleness results from constriction of the vessels. The secondary result of the trauma on the vaso-constrictor is that they are paralyzed, and then the vaso-dilators dominate with a resulting red line.

Bernard, in 1851, was the first to show conclusively that the sympathetics controlled the caliber of the blood-vessels. Any one who has long practised medicine, observing the heart and the aorta, will be able to note that the heart itself, and the aorta, have seasons of dilatation and contraction. For example, in many spare, neurotic women it is common to note that the aorta has periodic times of powerful rhythms or beatings. With the hand on the abdomen, the inexperienced announces a growing aneurism of the abdominal aorta. The aorta beats with such tremendous force that the patient will call the physician's attention to the phenomenon. A few hours subsequently its rhythm will be quieted and in a normal state. This phenomenon of the excessive abdominal aortic rhythm, or beat, is perhaps due to the excitation of the local nerve centers which control its caliber; for I could scarcely detect the excessive arterial beat in another portion of the body, as the wrist. At such times the heart acts slightly differently from normal. It is a little more noisy and appears as if it were dilated more than usual. Another phenomenon in regard to nerve centers which control vascular tone (contraction and dilatation) may be observed in the heart. By careful watching of the heart of an individual, one may note that the heart changes at times in both its method of beat and its size. Occasionally the heart will dilate, beat with more noise, continue so for some hours, and then subside to its natural state. This phenomenon, as well as that of aortic dilatation and contraction, is doubtless due to the controlling sympathetic nerve centers localized in the substance or immediate vicinity of the heart and aorta. The heart, like a blood vessel under the controlling vascular

Figure 5.

135, first sacral ganglion (R); 138, third sacral ganglion; 139, branches from second sacral to uterine cervical ganglion; 128, third sacral nerve (L); 166, int. pudic nerve going around spine of I; 119, hypogastric plexus; 157, int. pudic nerve; 133, fourth sacral nerve (R); 143, uterine cervical ganglion; 140, branches from third and fourth sacral to uterine cervical ganglion; 129, fourth sacral nerve (L); 160, branches of hypogastric plexus which do not enter the uterine cervical ganglion; 142, uterine cervical ganglion; 161, fallopian tube; 162, ovary; 154, uterine nerves; 151, uterus; 163; round ligament; 144, branch to levator ani; 141, uterine cervical ganglion; 164, acetabulum; 148, ureter; 155, rectal nerve; 152, bladder nerves; 149, bladder; 150, vagina.

nerve centers of the sympathetic, dilates and contracts and varies its rhythm still more within wide ranges. I have never seen this periodic dilatation noted in any book. About the same as nothing may be found in books on this peculiar periodic dilatation and vigorous beating of the abdominal aorta.

7. The abdominal brain (the solar plexus, the semilunar ganglion) may be viewed as a gigantic vaso-motor center for the abdominal viscera. The dilatation and contraction of the heart and aorta, with the periodic varying of the vigor of their rhythm (without recognizable disease), may be referred to this king of vaso-motor centers—the abdominal brain. In the progress of life's vascular phenomena the abdominal brain, as a vaso-motor center, exercises very dominant and quite independent prerogatives.

8. The dependence and independence of the cerebro-spinal and sympathetic system of nerves may be compared to the state and federal government, or the municipal and state government. The former run in harmony; when friction does not arise. Yet the state lives quite a distinct individual life, quite independent from the federal government. The life of each is dependent, however, on the other. The internal life of each (as of the sympathetic nerve) maintains itself.

9. The sympathetic system alone would maintain life (nutrition, secretion, circulation), especially in each viscus, but the cerebro-spinal system co-ordinates the various viscera as a whole into a definite purpose or plan. The cerebro-spinal system is an executive to suggest or organize the efforts of each system, ruled by the sympathetic, to combine for a common object—the continuation of an organized subject. The efforts of the circulatory system would be useless were they not combined with all the efforts of the digestive system, as well as those of the genito-urinary system. The cerebro-spinal system simply co-ordinates the various independent systems (circulatory, digestive and genito-urinary) into a unit of life.

10. The phenomena of vaso-neurosis of the extremities

would indicate a great degree of independence of the sympathetic nerve.

11. The ordered richness of the sympathetic nerves in ganglion cells, similar to the cerebro-spinal ganglia, would tend to demonstrate its independence.

12. The accumulation or aggregation of ganglion cells in the sympathetic should be sufficient argument for considering them as small brains, nerve centers of life's action.

13. The independence of the sympathetic nerve may be observed in the fact that as it departs more widely from the cerebro-spinal it increases in elements. Increased distribution shows increased aggregation of ganglion cells, e. g., the Meissner-Billroth and Auerbach's plexuses in the small intestines.

14. There is a partial necessity that the sympathetic be relatively independent, at least be out of the control of the cerebral center. The viscera being necessitated to be in constant activity, constant rhythm, should be beyond the control of the will, so that man cannot speculate on his viscera. The intellect cannot disturb the function of the viscera. The actions of the sympathetic ganglion are beyond the power of the will.

15. A stubborn opponent of the independence of the sympathetic nerve (Hermann) freely acknowledged that automatic and reflex co-ordinate movements and secretions can be the indication of the sympathetic ganglion cells quite independent of the cerebro-spinal symptom.

16. A significant partial independence of the sympathetic may be observed in peritonitis. The reflex irritation induced by the peritonitis causes extreme vaso-motor contraction in the skin. The skin becomes waxy pale, the blood is forced out of the skin by contraction of the vessels and the patient dies gradually from circumference to center. The heart at first attempts to work more vigorously to send the blood to the skin vessels, but the harder the heart works in sending the waste-laden irritating blood to the vessels, the more they contract and gradually death approaches the heart. The independence of the grip of the sympathetic

nerve is seen in the gradual death of the patient, beginning in the skin capillaries and ending at the heart. It is a good illustration of the fact that irritation of the sympathetic nerves may be sufficient to force all blood out of a part even to its death.

17. Vulpian severed the sciatic and brachial plexuses and waited until the pulp of the animal's corresponding paws became pale. Now, by irritating the pulp of the paws a local congestion could be produced. Hence reflex irritation of vaso-motor nerves can be limited to the particular organ or tissue supplied, showing a considerable degree of independence.

18. It has been suggested by Fox that myxedema is associated with the independence of the sympathetic.

19. Compression or macroscopical injuries of the cervical portion of the sympathetic products such a marked physiologic phenomenon that it demonstrates in itself a considerable degree of independence of the sympathetic. The manifestation of compression or injury of the cervical sympathetic is that of the irritation or paralysis. Trauma of the cervical sympathetic shows marked independent functional disturbances. Exophthalmic goiter is considered, even by the skeptical Eulenberg and Guttman, as a paralysis of the cervical sympathetic. If the latter can produce such vast changes, and such a dreadful disease, how great must be the influence of the abdominal brain in its independence. In exophthalmic goiter the independence of the sympathetic seems dominant, for of the great triumvirate in that disease—cardiac palpitation, protrusion of the eye-ball and enlargement of the thyroid gland—the cardiac palpitation seldom fails. Few experimenters or observers fail to connect the cardiac disturbance with the cervical sympathetic, showing how dominating it is in this case.

20. The gastro-intestinal secretions appear to be carried on automatically by the Meissner-Billroth (aided by the Auerbach) plexuses of nerves, which are sympathetic ganglia—automatic visceral ganglia. The automatic visceral, hepatic, renal, gastro-intestinal and menstrual ganglia, all show a marked degree of independence. They produce

rhythm in the viscera—activity and repose. Undisturbed they rule secretion harmoniously, but disturbed anatomic visceral ganglia induce (a) excessive secretion, (b) deficient secretion and (c) disproportionate secretion. The last is the most detrimental, for it creates fermentation and unbalances nutrition.

21. The independence of the automatic visceral ganglia of the sympathetic may be noted in the idea that if one viscus becomes diseased it may disturb all the others by reflex action.

22. If one viscus becomes diseased the next to become diseased is the one connected with the diseased viscus by the greatest number of nerve strands. If the uterus becomes diseased the next viscus in order is generally the stomach. However, this is probably due to the fact that the disturbed stomach functions are easily observed.

23. The abdominal brain is a center of organization for impressions received from distal viscera. It is a gigantic vaso-motor center for the abdominal vascular system. The abdominal brain demonstrates its independence by its definite method of reorganizing reflex actions. When an abdominal viscus is mildly ill, the abdominal brain reorganizes the reflex impressions and transmits them mildly to adjacent viscera. But if a viscus is severely and especially chronically ill, the abdominal brain reorganizes the reflexes and transmits them violently to the active viscera, according to the degree of illness. Also the reflexes reorganized in the abdominal brain are transmitted outward to the viscera with greatest force on the lines of least resistance, which means that the nerve forces travel on the plexuses the best where there are the greatest number of nerve strands.

24. The independence of the sympathetic nerve may be observed in the phenomenon of sleep. It never ceases action nor sleeps, while the cerebro-spinal is in abeyance, for about one-third of our life.

25. E. L. Fox reports two cases of compression myelitis in the cervical portion of the cord unattended by any oculo-pupillary or vaso-motor paralysis. This would tend to

show the independence of the sympathetic, especially the cervical sympathetic.

26. Experimenters report that irritation of some portion of the cervical sympathetic will produce secretions from the parotid and submaxillary glands.

27. Fox asserts that irritation of the peripheral end of the cervical sympathetic will cause protrusion of the eyeball, secretion will cause sinking of the eyeball, and a slight flattening of the cornea. We know that in the lids are sets of smooth, muscular fiber innervated by the sympathetic, and by contraction of these the lids are opened and so the eye-ball is uncovered.

28. In general it may be said that the sympathetic presides over involuntary movements, nutrition and secretion, holds an important influence over temperature and vasomotor action, and is endowed with a dull sensibility.

29. Experiments show that after destruction of the medulla oblongata and brain of the frog irritation will cause congestion of the limbs.

30. The occurrence of pigmentation in the skin of the frog, after destruction of the cerebro-spinal axis, shows the independence of the sympathetic.

31. Each histologic unit has its own nervous system which is sufficient for it within certain limits.

It may be said that the object of the lateral chain of the sympathetic is to make known the great ganglionic system to the cerebro-spinal system.

32. The ganglia of the uterus (sympathetic) are independent centers for reflex action. That it can act independently may be shown by the expulsion of a child after the death of the mother. It has a powerful reflex action on the heart. It is a great independent sympathetic ganglion. Associated anatomically with the abdominal brain are the following plexuses: (a) the diaphragmatic; (b) the supra-renal; (c) the renal; (d) the spermatic; (e) the superior mesenteric, which intimately connect it with all the abdominal viscera.

33. The expulsion of feces per rectum after death of the patient shows that the sympathetic ganglia of the bowels are independent centers for reflex action.

34. Pigmentation of the skin in the frog, after destruction of the cerebro-spinal, demonstrates the independence of the sympathetic.

35. The abdominal brain is a great reflex center. Vasomotor centers are organizing centers, and preside over the co-ordination of the visceral rhythm. The abdominal brain is a ganglion of far reaching significance. It has many connections with viscera and possesses vast influence over the circulation. It presides closely over the secretion of the abdominal organs.

36. That the sympathetic is the only nervous system belonging to some of the lower animals is open to doubt; for if that were the case no argument would be required to demonstrate the independence of the sympathetic. The distinction of the cerebro-spinal and sympathetic as to sleep or repose, since it cannot be proven, must be dropped. In any argument we must admit the very intimate and mutual dependence of the sympathetic and cerebro-spinal nerves on each other.

37. The essential feature of the pathology of the sympathetic, and also one which tends to show its independence, is that the irritation in one organ may be reflected through a sympathetic ganglion and thus disturb the balance of the viscera. The best, most common and convincing, example is irritation of the cervico-uterine ganglia, which is directly reflected to the abdominal brain, where the nutrition is reorganized and sent out to all the nerve plexuses.

38. The degree of independence of the sympathetic nerve must be worked out on the lines of experiment and observation of the effect of disease on its different parts. To what degree is the abdominal brain a center for the reorganization of forces, how does it modify and transmit receptions? How supreme is it over the visceral ganglia or does it co-ordinate their action to a definite plan? Does it enhance or prohibit their action? Is the abdominal brain a reflex arc for nerve forces passing from one organ to another? In other words, will one diseased organ unbalance all other organs by transmitting its irritation by way of the reorganizing abdominal brain?

CHAPTER V.

ANATOMIC AND PHYSIOLOGIC CONSIDERATIONS.

"The first questions to put to a witness are as to his name and place of residence, and his means of knowledge of the facts concerning which he is expected to testify." —*Judge Charles B. Waite.*

After considerable microscopical investigation I am convinced that we do not know the whole sympathetic nerve, nor do we fully know its distribution because of its tenuity. This remark is made as evidence gained in long microscopical labors on the peritoneum, in which I have been interested for years. In the peritoneum we cannot tell the function of a nerve from its microscopical appearance. We may assert that the width of the nerve indicates its length, that a wide nerve is a long nerve.

Now a sympathetic nerve is a non-medullated nerve, i. e., the white substance of Schwann is lacking, at least it is not visible by our present optical instruments, or the present known reagents. However, it appears to me to be present in Remak's bands (sympathetic fibers), though in an exceedingly thin layer. Again, many nerves in the peritoneum begin with a medullary sheath and end without one. The nerve is sheathed for part of its course and non-sheathed for another part. But whether we are to name a nerve sheathed in its whole course, or a part of its course, a sympathetic or a non-sympathetic, depends upon whether it shows a different function. In ordinary parlance a sympathetic nerve should have no visible sheath of Schwann, i. e., no medullary sheath. A sympathetic nerve is perhaps better known by its function than by its microscopical appearance. In fact no microscopist can decide merely by the appearance whether a nerve be sympathetic or non-sympathetic, unless he claim that all non-sheathed nerves are sympathetic. For one can

trace the medulla on a nerve in the peritoneum for a long distance when suddenly it disappears. Should one meet this nerve unsheathed in any portion of the peritoneum, he could not decide upon its function. At present we must discuss the function and not the microscopical structural differences.

One of the best places to study the sympathetic nerves is in the peritoneum of the kitten (when about six weeks old). The reagent best suited for practical microscopical work is as follows: Acetic acid 5 parts, gold chloride 1 part, and water 994 parts. The rabbit's peritoneum is quite good, but not so good as the cisterna lymphatica magna of the frog's peritoneum. Now it is not difficult to trace the gangliated cords lying on each side of the vertebral column. In spare subjects the branches running from the cords and ganglia are plainly visible. By a little care we can trace the branches of the ganglia and cords directly to the brain and spinal cord. The sympathetic system lies in front of the cerebro-spinal, as a secondary system enclosed in a cavity, the thoraco-abdominal, just as the cerebro-spinal is enclosed in the cerebro-spinal canal. The sympathetic system is characterized by having non-medullated nerve fibers. It frequently has large round ganglion cells enclosed in thick dense capsules.

The ganglion cells lie scattered over considerable areas, and are separated by dense, thick portions of connective tissue. The ganglion cells of the sympathetic do not atrophy in early old age, as claimed by some, for before me lies a beautiful microscopical section of the abdominal brain of a woman who died at about the age of 72, in which the characteristic feature is the numerous large ganglion cells ensheathed in thick connective tissue capsules. It may be that in some cases the superior cervical ganglion does develop an excess of connective tissue which crushes out the delicate ganglion cells, but such cases I have not observed in the abdominal brain, which must serve some great economic plan in the system. The significance of the abdominal brain and sympathetic system must not be forgotten, as children are born without a brain, and some reports note the absence of the medulla also. In such children the heart

and viscera have been kept going by the sympathetic system. Dr. W. F. Ball, of Mantua Station, Ohio, reported such a case to me.

Sympathetic nerve is characterized by accumulations of cells at certain points known as ganglia. In the abdomen and chest the ganglia have a regularity of location corresponding to definite segments of the body. There is a long chain of such ganglia situated on each side of the vertebral column, known as the lateral chain of sympathetic ganglia, and extending from the first cervical to the last sacral vertebra. Two fine, small cords connect the spinal cord with each of the ganglia of the lateral chain, making a close and intimate relation of the spinal cord and lateral chain. The spinal cord is doubly connected with the lateral chain. The medullated branch passes from the anterior root to the ganglia. The non-medullated root passes to the blood-vessels of the cord. The lateral chain is well protected by adjacent bony structures from any injury or pressure by viscera.

In front of the lateral chain there are located three nerve plexuses; one in the chest, the cardiac; one in the abdomen, the abdominal brain; and one in the pelvis, the utero-cervical, or as I prefer to call it, the pelvic brain. The thoracic and abdominal plexuses are single, located in the ventral line of the body and possessed of a large amount of nervous ganglia and cells, especially the abdominal brain. The pelvic plexus is double, situated on each side of the cervico-uterine junction, and is quite a massive collection of ganglia and nerve cells. All three central plexuses, the thoracic, abdominal and pelvic, are bound by intimate and very close relations with the lateral chain of sympathetic ganglia. Every viscus is profusely supplied with the sympathetic strands, and the vast number of cords and ganglia, like the equalizers on a horse power, hold in intimate relation all the viscera in a delicate balance. Specialists are beginning to recognize the wonderful sympathetic balance of all the viscera, for when one gets out of order it untunes the chorus of the whole. In fact if a viscus in an adult is disturbed, it is generally the genitals, and it soon unbalances the re-

mainder. It is easy to note the large cords, the ganglia and the invertebral plexuses of the sympathetic system, to note their distribution and the relations of the ganglia to the viscera in spare subjects hardened by alcohol. It is not difficult to see, even in rough, incomplete experiments, that there is a certain independence of the ganglia distributed to the viscera. Though the latter are seen to be in close relationship with the great structure of the sympathetic, yet they show definite, independent action. An hour after death one can induce the viscera in a dog to act by slight irritation or stimulation. Perhaps little remains to be discovered concerning the arrangement of the automatic ganglia in the viscera, or the structural arrangement of the cerebro-spinal and sympathetic systems. But much remains to be discovered in regard to the functional relations of the cerebro-spinal and sympathetic systems. Each system may contain structures of the other, or not. As a bird's eye view of the sympathetic nervous system we may produce the following:

1. A series of distinct ganglia connected by nerve cords, extending from the base of the skull to the coccyx.
2. Automatic visceral ganglia.
3. A series of three centrally located prevertebral plexuses, situated in the thorax, abdomen and pelvis.
4. A series of communicating and distributing nerve fibers.

The above propositions may be reduced to two elements, viz.; nerve fibers and nerve cells, or ganglia.

The caudal end of the sympathetic ends in a nerve mass known as the ganglion impar, and the head (frontal) end ceases in the ganglion of (Prof. Francois) Ribes (of Montpelier, France, 1800-1864). I must confess that my searches for Ribes' ganglion have not been fully successful.

We find the sympathetic nervous system very widely distributed and it must not be considered improbable to find sympathetic centers in the cerebro-spinal axis. The seat of a ganglion may be anywhere and yet not partake of the adjacent surroundings, i. e., sympathetic ganglia may be situated in the cerebro-spinal axis, yet not be an integral part of it, particularly as regards function. Thus we may con-

sider the vaso-motor center, the cardiac, and other centers, located in the medulla and cord, not to be a part of them.

This view must hold as a fact, for blood-vessels which necessarily supply all parts of the body, brain or spinal cord, must be supplied with sympathetic nerves to regulate their caliber, but neither the nerves nor the blood-vessels are of the cord or medulla. The sweat, heat (flashes) and vaso-motor (flushes) centers are located in the medulla and segments of the cord. Pathologic states, as at the menopause, make all these centers painfully manifest. Doubtless the genital center lies in the lumbar portion of the cord, though automatic visceral ganglia exist in the genital organs, such as I have formerly designated "automatic menstrual ganglia." Such ganglia require a month to accomplish a rhythmical cycle; they explode monthly. In the spinal cord there exists a linear row of cells known as the columns of the late English investigator, Dr. Clark. Some think that Clark's columns exercise the function of vaso-motor action, i. e., control the caliber of blood-vessels. But as Dr. Fox states, this column of Clark does not exist throughout the whole length of the cord. Should further investigations demonstrate that Clark's columns have a vaso-motor function it would go a long way in proving considerable independence of the sympathetic nervous system.

This independence, however, does not entirely depend on the supposed vaso-motor column of Clark. Definite, though limited independence can be observed in portions of the sympathetic nerve by any one who will carefully perform experiments on the lower animals. We of course do not overlook the idea that the sympathetic system and cerebro-spinal system are so intimately co-related that one so blends with the other that all action seems lost in the cerebro-spinal mass.

When the spinal cord and brain have lost control of the intestines they assume a wild and disordered action, as may be seen in a person dying of brain disease. In cases in which at the autopsy we could discover no brain disease I have found from one to four invaginations after death. In such cases, doubtless, after the cessation of the function of

the cerebro-spinal masses, the sympathetic fell into a wild, confused and disordered action. The muscular wall of the gut assumed an irregular action producing invagination. This latter is due to irregular action of the muscles in the gut wall.

In a certain sense we may look at the nervous system as composed of two parts, viz.: a cerebro-spinal part and a sympathetic part, connected by a number of single, fine, short, non-medullated strands. These strands really connect the ganglia of the sympathetic with the brain and cord. With such a constructed apparatus before us it might be stated that the sympathetic system simply consists of branches of the cerebro-spinal system. It may be represented as a branched roadway which distributes forces from the spinal cord to the viscera. It may be considered as overflow paths to carry nervous energy to the periphery. The ganglia of the sympathetic system are entirely outside of man's will-power. He cannot control them to hasten visceral action or retard it. It is plainly of utility to man to place beyond his will-power the action of viscera, as he would doubtless abuse it from selfish and other purposes.

But we must claim that the sympathetic nervous system is more than a mere branched roadway for the mere distribution of nervous energy from the cerebro-spinal axis. If nervous energy was merely to flow out to the viscera from the cerebro-spinal axis, why all this complicated, brain-like apparatus in the various sympathetic ganglia? No, the ganglia of the sympathetic are centers of nervous energy, accumulations of brain cells, of reflex centers, organized receivers of sensation and transmitters of motion. Is the cerebro-spinal system closely related to the sympathetic system by mere relations of structure, because the sympathetic ganglia and cells are imbedded in the great centers, or is it because the cerebro-spinal system has intrinsic and final control of the sympathetic?

In the dorsal region we find the typical spinal nerve of the morphologist with its three chief divisions, viz.; (a) dorsal; (b) ventral and (c) visceral branch. The visceral and vaso-motor branch is contained in the ramus communicans,

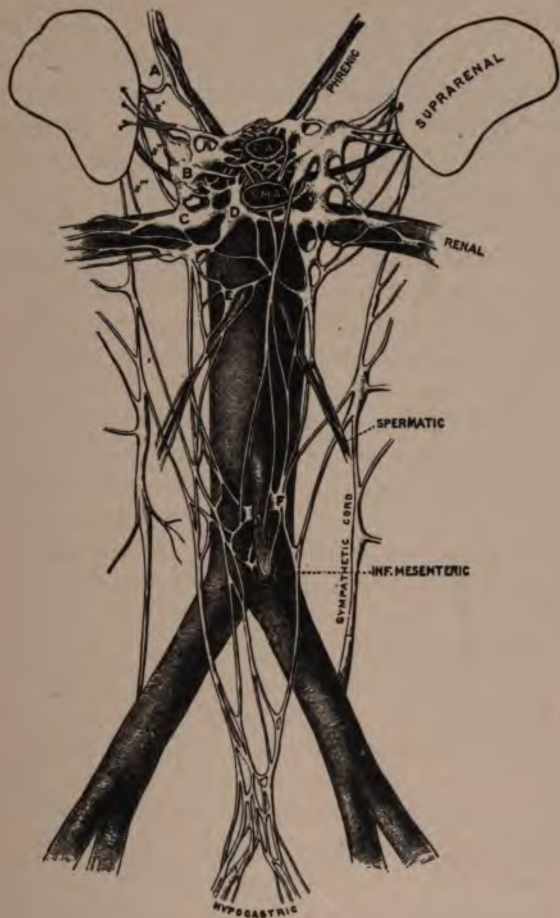

Figure 6.

(George Dancer Thane). Represents the solar plexus (abdominal brain) and aortic plexus, with the lumbar portion of the sympathetic cords in their relation to the aorta; c. a. cœliac axis and s. m. a. superior mesenteric artery, amputated close to their origin. Surrounding these two arteries like a net-work is the abdominal brain. A, is the phrenic ganglion found on the right side only; s1, great splanchnic; s2, the small splanchnic and s3, the smallest splanchnic nerve; b, right semilunor ganglion; c, renal ganglion; d, superior mesenteric ganglion; e, spermatic ganglion; f, inferior mesenteric ganglion.

which passes from the spinal cord to the lateral chain of the sympathetic or lateral ganglia, the demedullating centers. From this lateral chain of ganglia nerves pass onward to a second chain of ganglia, known as the prevertebral or collateral ganglia, i. e., the cardiac, abdominal brain, inferior mesenteric and pelvic brain. Milne Edwards called the nerves which pass from the lateral sympathetic chain to the collateral (prevertebral) chain, rami efferentes. Again, from the prevertebral (collateral) ganglia or plexus, nerve fibers pass into smaller terminal ganglia in the abdominal organs, or to what we designate the automatic visceral ganglia. We also have, besides the three distinct sets of sympathetic ganglia, connected with the ramus communicans, the posterior ganglia at the roots of the nerves as they issue from the spinal canal. The ramus communicans is then connected with four distinct ganglia.

1. The root ganglia (proximal ganglia), i. e., the ganglia situated on the posterior spinal nerves immediately after issuing from the cord.

2. The lateral chain of sympathetic (proximal sympathetic ganglia).

3. The prevertebral ganglia (distal sympathetic ganglia).

4. The automatic visceral ganglia, or terminal ganglia (distal sympathetic ganglia).

Leaving out the first of the ganglia, we note that the ramus communicans connects the spinal cord with three great systems of sympathetic ganglia, viz.: (a) the lateral chain, (b) the prevertebral chain and (c) the automatic visceral ganglia, making a complicated and vast system distributed over a wide area. In regard to the relation of this vast sympathetic system to the cerebro-spinal axis in general, three views have been held.

1. The first and perhaps the oldest view is that the sympathetic nervous system possesses a very great independence of action. The supporters of this view make the sympathetic system the exclusive center of motion and sensation of the thoracic and abdominal viscera. The chief establishers of this view were Volkmann (1842) and Bidder (1844). Their able defense of the independence of the sympathetic

nervous system is still entertained and published in the best anatomies. Bichat (1800) advocate the independence of the sympathetic ganglia, as one of the first and ablest supporters. In fact Bichat was one of the first to definitely conceive this notion. Before me lies a rare old book which I secured from an old English collection. It is written by James Davey, 1858, on "The Ganglionic Nervous System." Davey gives Bichat credit for knowledge of the sympathetic ganglion. Davey began to advocate the primary and essential independent function of the sympathetic in 1835 as is recorded in the "Lancet." Fletcher wrote (1837) on the independent action of the sympathetic.

2. The second view held was chiefly established by Valentine (1839). This view makes the sympathetic system an offshoot or dependent of the cerebro-spinal system. It would contain no fibers except those in the brain and spinal cord.

3. A third view considers the sympathetic to be composed of fibers from the brain and cord, and also of other fibers which arise in the various ganglia. According to this view every sympathetic nerve trunk contains both cerebro-spinal and sympathetic fibers. This view would consider all nerves sympathetic which arise in the ganglia and preside over the functions of organs.

The question might be asked, what are the functions of the sympathetic ganglia? It should be remembered that many different opinions mean unsettled views.

1. We may state that the ganglia demedullate nerves.

2. More nerves pass out of a sympathetic ganglia than enter it; hence the ganglion is likely the originator of nervous fibers.

3. The ganglia possess nutritive powers over the nerves passing from them to the periphery.

4. They are centers of reflex action, i. e., receivers of sensation and transmitters of motion.

We are therefore to consider as the subject of our theme:

1. The rami communicantes.
2. The lateral chain of sympathetic ganglia.
3. The prevertebral plexuses and
4. The automatic visceral ganglia.

There are some differences between the sympathetic system and cerebro-spinal axis which may be noted and discussed later.

1. We may claim that the sympathetic nerves are the visceral branches of the spinal nerves and hence have a distinct function, if not structure.

2. The individual fibers of the sympathetic nerves are of smaller caliber than those of the cerebro-spinal or somatic nerves.

3. The sympathetic branches preponderate in non-medullated nerves.

4. The fibers of the sympathetic nerves are interrupted by nerve cells or ganglia through which they pass.

5. Nerve cells are liable to accumulate into ganglia along a non-medullated nerve.

6. The sympathetic nerves tend to form closely meshed networks or plexuses, as Auerbach's and Billroth-Meissner's plexuses.

7. The somatic (cerebro-spinal) nerves supply the body wall. The sympathetic nerves supply the viscera. In the visceral nerves must be included vascular nerves.

We might call the various systems of ganglia of the sympathetic by numbers. For example, the lateral chain of sympathetic ganglia may be called primary ganglia. In the primary ganglia the chief nerves of the rami communicantes pass.

Again, we might call the prevertebral plexuses, the secondary ganglia. Many nerves from the rami communicantes enter the secondary ganglia without entering the primary ganglia.

Finally the automatic visceral ganglia might be called tertiary ganglia. In short we could conveniently speak of the primary, secondary and tertiary system of sympathetic ganglia.

Much interest is attached to the ramus communicans, i. e., the narrow isthmus which joins the cerebro-spinal axis to the sympathetic system. It is important to have a clear view of these rami communicantes, for through them pass the

rami viscerales and rami vasculares, i. e., the rami communicantes contain and transmit the vascular and visceral nerves, both subjects of profound practical interest in medicine and surgery.

In an anatomical sense writers understand by the term rami communicantes, two short nerves, a double connection between the cerebro-spinal axis and the sympathetic system, i. e., with the lateral chain or primary ganglia. One ramus communicans is white, medullated and passes directly out of the anterior root of the spinal cord chiefly to the lateral chain, but some fibers pass directly to the prevertebral plexus. This branch of the communicans contains the visceral and vascular nerves; hence the importance to all practitioners. The other ramus communicans is gray, non-medullated and passes from the lateral chain of ganglia to the spinal cord. It is a vaso-motor nerve, the purpose of which is to regulate the vessels of the cord and its meninges. It is well to remember that the term ramus communicans is a general term including all the kinds of nerves which supply the viscera and blood vessels.

I propose here to consider at some length the ramus communicans which supplies the abdominal viscera and blood-vessels. In the first place, there are certain fine, white medullated nerves, as Gaskell has pointed out, which pass from the spinal cord, in the white ramus communicans, between the second dorsal and second lumbar nerves inclusive, to supply the viscera and blood-vessels. These nerves should be named as Gaskell suggests, splanchnics. Hence we will have—1, the thoracic splanchnics; 2, the abdominal splanchnics and 3, the pelvic splanchnics. A peculiar feature of these white rami communicantes is that they are only found in a limited region of the spinal column. They begin as Gaskell notes at the second dorsal and end in the second lumbar. They have a very fine caliber and pass first into the lateral chain, where they become demedullated, and second into the prevertebral plexuses where the remainder become non-medullated. Hence, all the white rami communicantes which pass through sympathetic ganglia leave the

ganglia as non-medullated or as sympathetic nerves to attend to viscera and blood-vessels. Above the second dorsal vertebra the rami communicantes consist of the gray variety, i. e., they are peripheral nerves of the lateral ganglia. Below the second lumbar vertebra they are also of the gray peripheral variety.

CHAPTER VI.

THE PHYSIOLOGY OF THE ABDOMINAL BRAIN AND AUTOMATIC VISCERAL GANGLIA.

"Precedent is the terror of second rate men."—*Dr. Joseph Parker.*

"In the end thought rules the world."—*M'Cosh.*

The physiology of the abdominal brain and automatic visceral ganglia comprehends the real physiology of the sympathetic, as the chief portion of the former is included or counted in the latter. It may be asked, "What is understood by the physiology of the sympathetic nerve?" We understand by the physiology of any organ the use it yields to the economy, or the purpose it subserves to the animal. It may be stated in the beginning that it is difficult to definitely and exactly define the physiology of the sympathetic nerves, as they are often largely mingled with those of the cerebro-spinal system. The cerebro-spinal and sympathetic systems of nerves have a certain initial dependence on each other, like the individuals of well-ordered society. Yet certain limited liberties are assumed by both systems. The Federal government presides as a central power over the various states, but the latter assume many independent liberties of action. The states act and execute independently of the central government. So it is in the human body, an exquisitely perfect product of millions of ages; the sympathetic nerve, though dependent for much of its power on the cerebro-spinal axis, has in its influence over circulation and the abdominal viscera a certain independence of function.

The sympathetic is not merely an agent of the brain and cord. It generates action itself. It is, in general, a nerve center characterized by the power to receive sensation and send out motion. It has all the elements of any nervous system, viz.: a ganglion cell, a conducting cord and a pe-

riphery. It is not attempted here to argue that either the cerebro-spinal axis or the sympathetic nerve is absolutely independent of the other. The fact is that each nerve system has its own special duties. Both systems must be associated in order to carry on life's functions and purposes. It may be said that man and woman are independent of each other; but their association is required for the perfection of reproduction. In another place I have arranged quite a number of propositions to show that the sympathetic nerve enjoys a large degree of independence. In the discussion of its physiology certain topics must be discussed, in order to better comprehend the limits and factors of the field.

1. The abdominal brain, i. e., a reorganizing center.
2. A very important factor will be the vaso-motor nerves (i. e., vaso-constrictors and vaso-dilators).
3. The automatic visceral ganglia.
4. Glandular secretions (bile, urine, gastro-intestinal juices, milk, ova and semen).
5. Temperature.
6. Trophic nerves.
7. Pigmentation.
8. Reflex fibers.
9. Sleep.

The above nine divisions mark out a field for consideration. It may be broadly stated that all healthy movements initiated and sustained by the sympathetic nerves are involuntary movements.

The vaso-motor nerves. They are divided into vaso-constrictors and vaso-dilators, and to Claude Bernard belongs the credit of first conclusively showing (in 1851) that they exerted an influence over the caliber of the vessels. Authors agree, in general, that there are vaso-motor centers located in the spinal cord which control the caliber of vessels. Some place the vaso-motor centers in the vascular columns of Clark. Still another set of authors of great respectability claim that vaso-motor centers are located along the peripheral nerve branches. Doubtless there are in the walls of vessels nerve cells which are in connection with the vaso-motor nerves. These vascular ganglia, or nerve cells, send

fibers to the muscularis of the vessel, dilating or contracting it according to the nature of the despatched stimulus.

It is not yet definitely settled whether the vaso-motor nerves are constrictors or dilators, or whether there are distinct constrictors and dilators. Some assert that there is a constrictor nerve only and that dilation of the vessel is paresis of the constrictor. Later authority seems to point to a vaso-dilator and vaso-contrictor, and the fact that there are vaso-motor centers located on the vessel or adjacent to it. It is evident to observers and clinicians that local variation of circulation occurs in the genital or digestive tracts from reflex irritation. By slight irritation one can produce a white line (vaso-constriction) and by more severe irritation one can produce a red line (vaso-dilation). Cold first constricts the vessels, but it is rapidly followed by vaso-dilation, a redness. Now, this local variation of circulation occurs doubtless with more distinctness in the visceral organs which are so highly supplied with vaso-motor nerves, and so closely situated to the gigantic vaso-motor center, the abdominal brain. The significance of vaso-constricting nerves becomes very evident when it is recognized that they are so powerful that they can drive or squeeze all the blood out of a part.

In death from peritonitis the vaso-constrictors drive first all the blood out of the skin or periphery. The blood is forced into the large arteries and veins by the effect of the vaso-constrictors on the peripheral and smaller vessels. The vaso-dilators may be so effectively exercised that the blood escapes through the wall of the blood-vessels as in hemorrhagic peritonitis.

The vaso-motor nerves are of the sympathetic and exercise control over the caliber of vessels. The controlling of the lumen of vessels constitutes a vast field of physiology, in the domain of the sympathetic. It constitutes vascular tone. Section of the sympathetic dilates the vessels beyond the normal. One of the chief offices of the sympathetic nerve is to preserve the tone of vessels. The nerves that insure tone in vessels issue from the sympathetic. They are always active and never in repose,—a characteristic of the sympathetic nerve. They pass to the muscular coat of the ves-

sels and act as their permanent guardian, in preserving permanent vascular tone. Variation in this tone constitutes incipient disease. Doubtless the vascular tone is the result of a reflex matter, and the factor in the reflexion is the blood-wave, i. e., the trauma or irritation of the blood-wave on the endothelial membrane of the vessel induces the vaso-constrictors to act permanently in preserving vascular tone. Congestion is only the abolition of vascular tone. Goltz's percussion experiment demonstrates the reflex nature of the action of vaso-motor nerves, as by tapping on the exposed viscera he could produce dilatation of their vessels. Hence in this case the centers for reflex action must lie in the walls of the vessels themselves.

For a reflex act in the vaso-motor field, there must exist several factors, as

(a) muscular walls or contractile tissue.
(b) centripetal fibers.
(c) a center of reflexion.
(d) centrifugal fibers.

All these factors exist on and adjacent to vessels.

For the reflex centers of vaso-motor movements we may look to the cardiac ganglia, the abdominal brain or, especially, to the ganglia around the vessels or in their walls. Finally, we may claim that the vaso-motor nerves control the calibre of vessels, that they belong to the sympathetic and that those of the abdominal viscera are chiefly under the control of the gigantic vaso-motor center—the abdominal brain.

First, we must consider the abdominal brain, the semilunar ganglia or solar plexus, in the physiology of the sympathetic. This large ganglion receives sensation and sends out motion. It is situated at the root of the great visceral artery, i. e., at the foot of the celiac axis. It lies behind the stomach and entwines itself about the aorta and root of the celiac axis and superior mesenteric artery. In short, it is located at the roots of the celiac, renal and superior mesenteric arteries. It supplies all the abdominal viscera. It is a gigantic vaso-motor center for the viscera, as is shown by its location at the roots of the celiac, renal and

superior mesenteric arteries—the great abdominal visceral blood way. It is connected with almost every organ in the body, with a supremacy over visceral circulation, with a control over visceral secretion and nutrition, with a reflex influence over the heart that often leads to fainting and may even lead to fatality. No wonder that we may consider the abdominal brain the center of life itself, as the cranial brain is the center of mental and psychical forces!

The abdominal brain, or solar plexus, is composed of the aggregation or coalescence of a large number of ganglia. On the two sides of the abdominal brain are situated the semilunar ganglia—compact masses of nerve cells, nerve cords and connective tissue. During many dissections I have noted that the right semilunar ganglion is the smaller, doubtless because it lies behind the inferior vena cava, and hence has suffered from pressure atrophy. Each of the semilunar ganglia receives the great splanchnic nerve of the corresponding side. The other splanchnics may enter it, but it is more to enter the abdominal brain. It may be here stated that although the semilunar ganglia are located on the sides, they are practically so intimately associated with the solar plexus that we insist in combining all the names into one, viz.: that of Abdominal Brain.

All plexuses or strands of nerves are secondary. The significance of the abdominal brain in the visceral physiology, i. e., in life, may be compared to that of the sun over the planets. The influence of the sun rules the planets, though they are influenced by other suns and planets (e. g., the cerebro-spinal). The abdominal brain has ganglion cells (brain centers), nerve strands (nerve conductors) and a peripheral nerve apparatus, just as the cranial brain possesses all central conducting and peripheral apparatus. The abdominal brain can live without the cranial (shown by living fetuses with no trace of cerebro-spinal axis), while the cranial brain and the cord cannot live without the abdominal brain. The great sympathetic ganglia, of which the abdominal brain is the ruling potentate, is the center of life itself. So long as the forces of life, assimilation, circulation,

respiration and secretion proceed undisturbed, as in health, the abdominal brain remains a silent, steady, but ceaseless worker; but being unbalanced by peripheral or central irritation, it quickly manifests or resents the insult. From the abdominal brain large plexuses with numerous nerve strands pass to every abdominal viscus, connecting the viscera into a delicately balanced, nicely ordered, exquisitely arranged apparatus for the object of maintaining life. The nerve plexuses or strands are arranged along the highways of nourishment—blood and lymph vessels, and vary in size according to the importance of the viscus supplied.

CHAPTER VII.

CONSIDERATIONS FOR THE REMOVAL OF PELVIC AND ABDOMINAL TUMORS.

"But he did not lose sight of the present in these glowing visions of a future."—*Mrs. Catharine V. Waite, "The Mormon Prophet and His Harem."*

Having devoted some fifteen years to the study of pelvic and abdominal visceral disease, I have frequently desired to record some observations on the effect of tumors in the pelvis and abdomen upon the sympathetic system. Many dissections have convinced me that the vast ganglionic system, distributed to the viscera bordering upon the peritoneal cavity, together with other glandular organs of the body, plays a significant role if distributed. Besides, when it is noted that the heart, and blood, and the unstriped muscles of the body, are supplied by the sympathetic system, there becomes at once apparent its extensive as well as intimate connection with the whole body.

Special study in the physiology and pathology of the viscera develops reasons for the removal of abdominal and pelvic tumors not apparent from superficial observations. It is well known that shortly after the appearance of a tumor in the abdomen the health of the patient becomes more or less impaired. The functions of the organs become deranged; the heart suffers from abnormal action and structure; the digestion becomes more or less deranged. As the tumor increases in size, kidney diseases generally develop. The liver, forming bile, glycogen and urea, sooner or later becomes impaired in its rhythm.

The lungs lose their rhythm and become spasmodic, while the spleen shows its disturbance by pigmentary deposits in various portions of the body. An attempt will here be made

Figure 7.

112, genital ganglion; 173, third lumbar ganglion (R); 114, genito-rectal ganglion; 103, lumbar lateral chain of ganglia; 173, third lumbar nerve (R); 90, lumbar nerve; 91, lumbar nerve; 179, fourth lumbar ganglion (R); 104, lumbar lateral chain of ganglia; 181, com. iliac artery arising in this case at third lumbar vertebra; 188, inferior renal ganglia; 98, 90 and 100, ram. com.; 92, lumbar nerve; 105, lumbar lateral chain of ganglia; 174, fourth lumbar nerve (R); 189, fifth lumbar ganglion (R); 93, lumbar nerves; 114, genital ganglion; 115, hypogastric plexus; 134, first sacral ganglion (L); 179, fourth lumbar ganglion (R); 116, hypogastric plexus; 125, lumbosacral cord; 135, first sacral ganglion (R); 136, genital ganglion; 118, hypogastric plexus; 126, first sacral nerve (L); 170, lumbar sacral cord; 130, first sacral nerve (R); 158, right sacral plexus; 137, second sacral ganglion; 117, hypogastric plexus; 156, rectum; 127, second sacral nerve (L). From author's life-size chart of the sympathetic nerve.

to explain the pathological result of abdominal tumors on physiological and anatomical grounds.

The basis of the explanation will be by reflex action on the sympathetic nerve. It may be curtly observed that the pathology of the sympathetic nerve is reflex action. We will assume that the ganglia which are found in it, especially the abdominal brain and the three cervical ganglia, are points where forces are reorganized and distributed to the viscera. The first essential feature to observe in the diseased viscera is the disturbance in rhythm. Though any abdominal tumor may produce the same results, we will choose a uterine myoma to illustrate our views. It is a principle in physiology that when a peripheral irritation is sent to the abdominal brain the reorganized forces will be emitted along the lines of least resistance, so that the organ which is supplied with the greatest number of nerve strands will suffer the most. Practically this principle holds true in every viscus.

The great ganglia and cords, filled with nerve cells and nerve strands, labor in the sub-conscious region, the vast laboratory of life and assimilation. The cerebro-spinal axis receives sensations and emits motion, performing labors which minister to the mind and protect the body in avoiding destruction, or in acquisition.

The effects of the tumor on the heart may first be considered. An abdominal tumor induces fatty degeneration of the heart. When the uterine tumor irritates the peripheral ends of the hypogastric plexus, the irritation is transmitted to the abdominal brain and there reorganized and emitted along the splanchnic to the cervical ganglia, where, again, a reorganization occurs and the force then passes down to the heart by way of the three cardiac nerves. The irritation could pass directly from the uterine myoma up the lateral chain of sympathetics to the three cervical ganglia where it becomes reorganized. It no doubt transmits part of the irritation by way of the abdominal brain and part by way of the lateral chain. So far as the heart is concerned, the result is nearly the same, for the irritation is reorganized in each case in the three cervical ganglia and transmitted to the heart. It is of course necessary to consider that the irrita-

tion may be sent to the spinal cord by way of the vagus and there reorganized. In such case it is sent directly to the heart by the vagus.

It should be remembered that the sympathetic ganglia in the walls of the heart (Ludwig's, Bidder's, Schmidt's and Remak's) are numerous and large. Also that the network of cords with their ganglia, situated close to its surface, constitute an extensive nerve system. It consists of the great or deep cardiac plexus, otherwise known as the plexus magnus profundus of Scarpa, besides the superficial cardiac plexus, with the cardiac ganglia of Wrisberg, which is occasionally large from the coalescence of several ganglia, and may be represented by a meshwork. In tumors of the pelvis we are dealing with the effect on the vast cardiac sympathetic nervous system. The first manifest objective heart symptom is irregularity.

The irritation from the uterine myoma reaches the heart in two ways:

1. The irritation passes up the hypogastric plexus to the abdominal brain, where it is reorganized and emitted to all the viscera over their respective sympathetic plexuses. In the case of the heart it passes up the abdominal splanchnics to the three cervical ganglia of the sympathetic, where it is reorganized and sent directly to the heart.

2. Some of the irritation is transmitted by way of the vagi to the medulla, where it is reorganized and sent directly to the heart by the cardiac nerves which supply the heart from the vagus. This is more especially the case in the right vagus, as that is the cranial nerve which largely rules and supplies the heart and abdominal brain. Now, this irritation from the myoma goes on day and night. It gives the heart no rest. It flows to the heart in the midst of a diastole, or a systole. The first great characteristic of the heart (rhythm) is lost. Having lost its rhythm, the heart proceeds irregularly. Irregular action means a changed nourishment; continued irritation with disturbed rhythm induces the heart to overfeed itself, the result being hypertrophy.

It may be noted that this hypertrophy is not brought about in precisely the same way as is hypertrophy from valvulitis

or aortic insufficiency; but vaso-motor dilation must play a role in over-nourishing the cardiac muscles. It resembles more nearly the cardiac hypertrophy existing in goiter. That from the reflex irritation in myoma is also a moderate hypertrophy, so far as the writer has observed, and it is a very slow process. In the first stage the heart becomes irregular, in the second hypertrophied, in the third it takes on fatty degeneration. This is no doubt a preservative process, so that a large, vigorously beating heart will not rupture an artery in a degenerated state (atheromatous or fatty). It appears certain that many old cases of large uterine myoma are lost after skillful operations simply from fatty degeneration of the heart. It is common to observe palpitation in patients having uterine myoma, and palpitation is the characteristic symptom of a weak heart.

The automatic cardiac ganglia are disturbed by reflex irritation and take on an excessive nourishment. The irritation, sent to the heart over the hypogastric plexus, is in one sense an increased demand for action. The irritation, passing to the heart day and night, winter and summer, according to a physiological law, provokes hypertrophy, if the nutritive powers are good. If they are not good, the complement of hypertrophy—dilation—results.

A fatty degenerated or weak heart induces low blood-pressure, which is the bottom factor in waste-laden blood and deficient elimination. It allows local congestions and consequent impaired nourishment. The local force of such circumstances teaches to remove uterine and other abdominal tumors as early as possible, so that the patient will not be left with partially or completely damaged viscera.

Reflexes arising from the irritation of the sympathetic in the peritoneal membrane are profound in results. Irregularity, hypertrophy, and degeneration of the heart are the effects of a reflex act, accomplished mainly through the sympathetic system and due to irritation at the periphery of the hypogastric plexus. It is transmitted to the abdominal brain, to the three cervical ganglia, and some to the spinal cord, whence the reorganization of the forces occurs.

The organized nervous impressions then pass to the heart

over the six cardiac (vagi) nerves. This abnormal force deranges the fine balance of the heart's rhythm. The automatic cardiac ganglia become discolored, which in time disturbs vaso-motor action and consequently nourishment.

It may be remembered that the untoward influence on the heart, disturbing its rhythm and consequently its nourishment, is also aided and abetted by disturbing the caliber of distal blood-vessels which are controlled by the sympathetic system.

The liver does not escape the evil influence of the tumor. Abdominal tumors induce fatty degeneration of the liver. It may be asserted that an influence on the hepatic plexus of nerves alone could stop all secretion in the liver. If such a proposition be true, it need not be wondered that lesser irritations of the hepatic nerve plexus could so alter the secretion of the liver that it would degenerate the organ. The characteristic disturbance which arises from the uterine myoma is a derangement of rhythm. The liver has a rhythm due to (a) an elastic peritoneum inclosing it, (b) an elastic capsule (Glisson's) surrounding it, and (c) to the capacity of its cells to enlarge.

The occasion of the liver rhythm is food carried to it by way of the portal vein. When the peritoneal and Glisson's capsules and the cells are expanded to a maximum, the liver rhythm is at its climax.

Now, the products of the liver (bile, glycogen and urea) are sent to their respective homes by contraction of the elastic peritoneum and capsule of Glisson. The liver then gets its rest and repair.

The irritation from the periphery of the hypogastric plexus passes up to the abdominal brain, where it is reorganized and emitted to the liver. It goes to the liver from the tumor at all hours and deranges its rhythm. The irritation may attempt to induce a rhythm without food, or it may flash on to the liver at any stage in its rhythm. The liver rhythm is induced by the automatic hepatic plexus. So it may be asserted that the irritation of the uterine myoma deranges the rhythm of the liver. The second point to consider is the altered secretion in the liver, due to the

reflex irritation from the uterine myoma by way of the abdominal brain. The continued irritation increases the derangement and soon changes and impairs the liver nourishment. The complete process from food to end products becomes imperfect and a lower grade of tissue is formed, known as fat. The constantly irritated liver soon becomes able to form but little products beyond fat, and degeneration follows.

It is well known that women at the menopause frequently acquire liver disease. This is owing to the reflex irritation through the abdominal brain. The degeneration of the hypogastric plexus will not allow it to transmit sufficient physiological order to induce a monthly rhythm, so the accumulated energies flash on to the other organs, and the derangement of the liver is especially manifest, because its derangement is often followed by pigmentation (yellow or brown or black) of the skin. The uterine myoma then, by reflex action, disturbs rhythm and secretion in the liver, and so its nutrition. This ends in fatty degeneration.

For years I have observed that women with pelvic disorders have disturbed kidney action. In general this kidney disturbance is renal insufficiency, and it may after long irritation become organic disease. It may be well to give a general hint here as to why the kidneys suffer so much when either irritating tumors or inflammatory processes exist in the pelvic organs.

The kidneys, uterus, ovaries and Fallopian tubes develop from two very small points in the embryo called the Wolffian bodies. These develop from the mesoblast, as do the muscles, nerves, blood and lymph vessels, and form the genito-urinary organs. Arising from the same source and supplied by the same nerves and blood-vessels, the Wolffian bodies, the kidneys and genitals have an intimate and close connection. The abdominal brain sends out a vast chain of nerves to the kidney on each side, and the same brain sends out a vast chain on each side of the genitals. These and the kidneys are only different spokes in the same wheel, the hub of which is the abdominal brain. Diseases in the genitals, whether tumors or inflammatory processes, produce in the

urine not only diminished solids but also diminished fluids. Again, on the other hand, diminished kidney excretion (renal insufficiency) produces diseased or, at least, disturbed genitals. Any gynecologist of some years' experience has doubtless frequently observed that in women with diseased genitals and deficient renal secretion, by giving diuretics (water, compound spirits of juniper and spirits of nitrous ether) in small and oft-repeated doses, the diseased genitals will often improve in direct proportion to the increase of renal secretion. Deficiency of renal secretion irritates the genitals by non-removal of urinary solids. Diseased genitals irritate the kidneys by reflex action. This is all accomplished through the abdominal brain as a center. The genitals, kidneys and abdominal brain constitute a very vital triangle. In the middle of its base lies the significant abdominal brain and at the apex the important genitals, while the other two angles are occupied by the kidneys. The uterus and kidneys have the highest nerve and blood supply of all viscera, hence they experience more profoundly than other viscera the forces which are organized and reorganized in the abdominal brain. In the sympathetic nervous system the kidneys play a vast and immeasurable role. If by some irritation in the pelvis or abdomen the kidney begins to secrete insufficiently, the whole organism, together with the ganglionic nervous system, or the cyclo-ganglionic system, as Solly termed it half a century ago, will become poisoned from non-elimination. From this peculiar reflex action, of which the abdominal brain is capable, we may yet learn that disease of the pelvic organs of woman may yet be cured by diuretics, cathartics or diaphoretics. The intimate and close relations of the genitals and kidneys is plain anatomically and physiologically, as large bundles of nerves from the abdominal brain supply both. Clinically, then, closer relations have developed of late years as gynecology has progressed. The cyclo-ganglionic system is recognized as a finely balanced mechanism capable of prompt response when once its manifestations are understood.

For example, no one understands so well as the gynecologist the vital relation which exists between deficient

kidney secretion and diseased pelvic organs. Effective diuretics relieve many pelvic pains. Baths and diaphoretics subdue innumerable neuralgias and cathartics disperse dragging pains. A woman may have a sound kidney (as far as chemical examination of the urine may indicate) and yet reflex action from the genitals may induce it to secrete too little of fluids or solids, which not only further disturbs the genitals with waste-laden blood but disarranges the fine balance in other viscera with the same. Wherever this waste-laden blood advances it produces new points for reflex irritation, unbalancing the whole system. It seems to me there is no better point to work from in this consideration than the relation of the genito-urinary system to the abdominal brain. Clinical features are more manifest here than elsewhere. Gynecologists may even cure women of innumerable ailments by simply inducing them to drink water. I have accomplished much for women during the past ten years by inducing them to drink a full glass of water, containing half a teaspoonful of epsom salts in solution, every night on retiring. Dr. J. H. Etheridge has written instructively on renal secretion in gynecologic patients

During menstruation girls show distinct clinical symptoms of pain in the region of the kidneys, and of variation in urinary secretion, showing the close relation between this and pelvic disturbances. It is clear that this pain in the kidney region is due to reflexes from the menstrual organs, i. e., the uterus and tubes.

The kidney, in proportion to its size, has the highest nerve and blood supply of any viscus, except the uterus. According to the recent investigations at Johns Hopkins University, the kidney is supplied only by sympathetic nerves. It is a common observation that abdominal tumors are followed by kidney disturbances. Even the gravid uterus does not allow the kidney to escape irritation. This kidney disease brought about by abdominal tumors is reflex. It is a physiological principle that an influence acting through the nerves alone can arrest all secretion. Minor degrees of irritation will suffice to increase, diminish or change the kidney secretions. Irritation of an organ con-

tinued indefinitely, and modifying its action, may be sufficient to induce disease. Kidney disease resulting from abdominal tumors is chiefly chronic from the very nature of the case.

The first point to consider, as the initial step in chronic renal disease from abdominal tumors, is partial or complete obstruction to the flow of urine.

The second point to consider in chronic renal disease due to abdominal tumors is reflex irritation from distant viscera.

The third point of consideration is infection. As regards the first point—obstruction—the location and size of the tumor may be noted. A partially occluded ureter, through long continued pressure, will cause renal disease. Under this head would be classed mechanical impediments to the flow of urine.

If the obstruction is sufficient it will create hydronephrosis. If the hydronephrosis is long enough maintained the kidney will secrete until blood pressure is impaired, and then in a few months atrophy will follow.

The writer has proved by experiments on the dog that while the ureter is completey ligated, the kidney will shrink to about one-fifth its original size, in five months.

The pressure of the tumor on the ureter is a silent process not often recognized by the attendant. The obstruction of the ureter is like the quietly growing intestinal stricture, which is rarely recognized until some terrible disaster reveals a long series of old pathological conditions. The main idea in the obstruction, however, is that it is partial, and by raising the difficulty of urine flow, renal elimination becomes deficient. The blood then becomes waste-laden. If the obstruction is sufficient, the result will be hydronephrosis, which being long continued (without infection) results in renal atrophy, as the writer proved by tying the dog's ureter.

The second point—reflex irritation—is more significant, because it means that irritation from any viscus can be reflected to the kidney, over the renal plexus. The abdominal tumor irritates some contiguous viscus; this irritation quick-

ly passes to the abdominal brain, by way of the sympathetic plexus of said viscus, where the forces are reorganized and transmitted to the kidney. There is little doubt that the rise of temperature from passing a sound into a man's bladder is due to reflex irritation transmitted from an oversensitive urethra. It is probable that the so-called urinary fever is reflex. It modifies circulation by inducing local anemia and local hyperemia. In this way nutrition quickly changes. Examples may be seen in strictures of the intestine or ureter where the walls above the stricture are greatly thickened.

The chief point in regard to secretions in patients with abdominal tumors is a decreased or disproportionate secretion. It is common to observe a patient with a tumor secreting a small quantity of urine heavily laden with salts. The amount of urine voided at times appears as an alarmingly small quantity. Natural reasoning from clinical and physiological bases attributes the decreased quantity of urine to the irritation from the tumor transmitted over the renal plexus. Autopsies on women who die of tumors prove it beyond the shadow of a doubt.

Disproportionate renal secretion from the irritation of abdominal tumors is also common. Albumen is the chief element found. But phosphates, urates or sugar make up the varying scales of salts. Even the amount of water will vary within short limits.

The tumor of pregnancy is a common example of disturbed renal secretion due to reflex action. Thus deranged renal secretion is frequently due to reflex irritation, depending on the presence of an abdominal tumor. The change in the secretion consists in increase, decrease or disproportionate quantities. As each organ has its own distinct nerve plexus, so it should be understood that reflex action is carried along distinct anatomical lines.

As regards the third point—infection—in chronic renal disease from the presence of abdominal tumors a serious condition appears.

The genito-urinary tract can be infected at any point from the kidney cortex to the urethral end. If the tumor presses

severely enough on the urinary tract, a perforation will occur, and from this perforation infection will travel in either direction—toward the urethra or toward the kidney.

The result of perforation of the urinal tract will be nephritis and cystitis. The perforation is most likely to occur in the bladder, from which the infection ascends the ureters to the kidney. It is not necessary to have a large tumor to perforate the urinal tract; simply a suppurating focus is sufficient. It is not necessary to have a complete perforation of the urinal tract to allow infection to gain an entrance, for the germs, or their products (ptomaïnes), may penetrate a thin pathological wall. The final result of an infected urinal tract is ureteritis, with parenchymatous or interstitial nephritis. The writer has observed some disastrous results from pyosalpinx perforating the bladder and intestines. It may here be noted that Doran, a most excellent observer, made post-mortem examinations of forty women who had died of ovarian tumors, and thirty-two had severe kidney disease. This means that 80 per cent. of those who died from ovarian tumors had kidney disease. No doubt the kidneys were diseased from the presence of tumors. Obstruction, reflex action or infection was the causative factor of renal disease, resulting from pressure of tumors.

A good sample of obstruction, reflex irritation and infection of the urinal tract is seen in cases of gonorrhea in men which end in stricture and "catheter life." The stricture generally arises in the urethra and marks the onset of obstruction to the urinary flow. This increasing obstruction induces constant reflex irritation, and yet the man is not subjectively or objectively sick. But now he begins "catheter life," which means infection. It means self-destruction by his own hands. Thus to obstruction and reflex irritation of the urethra he has added the fatal infection carried on his catheter, which too frequently makes the fatal march swiftly onward and swiftly downward.

The kidney suffers similarly from any abdominal tumor, and chiefly by reflex irritation, which passes from the abdominal brain by way of the contiguous plexus, where it is

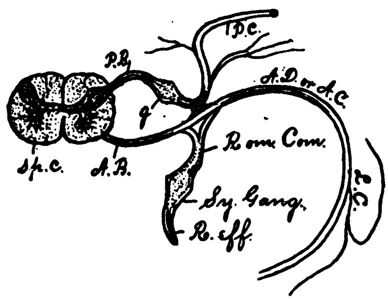

Figure 8.

(Author). Represents a plan of a dorsal nerve. Sp. c., spinal cord; p. b., posterior branch; a. b., anterior branch; g., ganglion on posterior root; ram. com., Ramus communicans; sy., gang., sympathetic ganglion; p. c., posterior cutaneous; a. d. or a. c., anterior division; l. c., lateral cutaneous branch.

reorganized and emitted on the large renal plexus to the kidney. The writer notes that those women who come to him for the purpose of having tumors removed have a very variable quantity of urea in the urine. At the Woman's Hospital the writer has the urea tested in every case of laparotomy, and the amount varies from five to eleven grains to the ounce. The tumors appear to play a significant role in the production of varying quantities of urea.

What has been said in regard to kidney disease by reflex irritation is equally prominent in floating or excessively movable kidney. The dragging of the kidney on the abdominal brain, through the renal plexus, unbalances the viscera very distinctly. The patient suffers from nausea, from constipation, from disturbed secretion and circulation and from dull dragging pains. The patient may sometimes suffer similarly from an artificially fixed kidney, as I have observed often after a nephropexy of my own, when viscera, which are normally excessively mobile or fixed, are dislocated, they lose a part of their physiology, which is motion. Stone in the kidney is a typical sample of disturbance in the sympathetic nerves. One of my patients was idle ten months before I removed a renal calculus, and she suffered from an unbalanced sympathetic nervous system just as a woman would from diseased genitals.

Abdominal and pelvic tumors produce disease in the digestive tract. Object lessons are not only impressive to children, but to adults. The wonder is how the visceral organs can adapt themselves to growing and movable tumors. To-day we removed an ovarian tumor the size of a child's head with a narrow pedicle of seven inches. The tumor could be pushed into almost any position of the abdomen. Yet this tumor, which the patient has had for about ten months, appears to have told on her health. To be sure it glided where it would without any apparent trouble, but doubtless the continued, repeated and accumulated traumas on the other viscera kept up a constant story of visceral insult. Every step she took induced the tumor to jog and roll around in the abdomen. Occassionally it would become partially wedged in the pelvis, producing congestion and

disturbed circulation and insults to the delicate, fine nerves of the peritoneum. This solid tumor was not like the yielding, soft viscera; but wherever it would lie it pressed and disturbed circulation. It is probably true that smaller tumors of the pelvis and abdomen produce much more traumatic visceral insult than larger ones which move but little. The real wonder was that such a tumor as the above could glide about among the mobile viscera so long and not become rotated on its axis.

It is probable that secreting or glandular organs suffer the most from abdominal tumors, because the main damage is through reflex action, and the glands are the most highly supplied with (sympathetic) nerves. The digestive tract should be studied by means of (a) sensation, (b) motion and (c) secretion. The slow, continuous pressure of abdominal tumors produces but little recognizable sensation in the digestive tract. Another point is that from inexperience the patient cannot localize the pain in the digestive tract, but refers it mostly to the abdominal brain; so that the subjective sensation in the digestive tract, due to tumors, is of small value. As regards motion in the digestive tract, in cases of abdominal tumors, one can say that in the great majority of fair or large-sized tumors motion is diminished and constipation is the rule. But the main study of damage of abdominal tumors in the digestive tract will be through the secretions. Secretions are altered in three ways: (a) they may be excessive, (b) decreased, or (c) disproportionate.

The final result is indigestion. The irritation from the tumor is carried on the plexus of any contiguous viscus to the abdominal brain, where it is reorganized and emitted to the digestive tract over the gastric plexus, the superior mesenteric plexus and the inferior mesenteric plexus. In any case the brunt of the forces ends in the ganglia which lie just below the mucous membrane, the ganglia constitute what is known as Meissner's plexus, which rules secretion.

If the irritation be of such a nature as to produce excessive secretion, diarrhea may result. The excessive secretions will decompose and induce malnutrition. It is com-

mon to observe in women with tumors spells of indigestion, and especially in times of excessive irritability. No doubt at such times the irritation assumes a prominence not experienced on other occasions. If the irritation is of such a nature as to diminish secretion, constipation will likely result. An inactive digestive tract is the forerunner of non-elimination and a waste-laden blood. It is common to observe women with tumors to have anorexia for weeks at a time, accompanied by constipation. No doubt the main chapter in altered secretion consists in what may be termed disproportionate secretion. The elements which make up the digestive fluid are not secreted in normal quantities; one element is deficient and the other is excessive. The normal relations of acidity and alkalinity are changed so that constant fermentation arises. Again, from the irritation of an abdominal tumor individual organs do not secrete their normal quantity or quality.

The liver may secrete excessively or deficiently. The pancreas may do too much or too little. The irritation may cause segments of the alimentary canal to secrete excessively or deficiently and thus destroy the finely balanced secretion of the canal as a whole. The stomach or small intestines may by the irregular irritation do too much or too little, or act irregularly. This produces decomposition in the fluid and fermentation results. Such women are continually troubled with "wind on the stomach." Diarrhea and constipation quickly alternate and the result is frequent attacks of acute indigestion.

Disproportionate secretion is the most frequent and disastrous, because the irritation from the tumor is irregular. It storms one day and sleeps the next. But the nature of irritation is to be inconstant and to rush pell mell over the nerve plexuses, or to assume a profound quietude. Irritation scampering over the plexuses month after month is sure to be followed by indigestion, malnutrition, anemia; and the final ending of the poor patient is neurosis.

The subject of pressure of abdominal tumors on the digestive tract may here be considered. The effect of pressure acts in two directions—(a) on the alimentary canal and

(b) on the tumor itself. The effect on the canal may be (a) to derange the secretion and motion of the segment pressed on; (b) to perforate the canal; (c) to obstruct the canal The more serious effect of the tumor pressure on the digestive tract arises from the changes which result in the tumor itself. The changes arising in the tumor from the alimentary canal are: (a) inflammation, (b) adhesion, (c) suppuration and (d) rupture. The main idea is that infection or its product (ptomaines) enters the tumor through the gut wall.

It frequently happens in laparotomy that some part of the digestive tract is firmly adherent to the tumor. The cause of this adhesion is the formation of exudates into organized tissue which binds the gut wall and tumor together. The irritation from the contact of the gut wall and tumor induces the passage of germs or their products (ptomaines) through the wall of the intestine, which gives rise to an exudate. The writer has fully satisfied himself that considerable inflammation, adhesion and suppuration, which are found to exist in tumors, are due to the passage of the morbid matter through the intestinal canal.

It is not uncommon for one to find from an inch to a foot of gut firmly attached to a tumor, when the great gateway of infection, the tubes, shows no traces either ancient or recent. The vermiform appendix is a certain source of infection, not only in abdominal tumors, but also of the genital organs.

Considerable inflammation and adhesion of intestines (and occasionally other organs) when abdominal tumors exist is accounted for by the infection passing through the gut wall into the tumor. As regards suppuration in abdominal tumors, due to infection arising from the alimentary canal, it may be said that it is only a stage in advance of inflammation, and that inflammation is only a degree short of suppuration. So that in one sense they are the same process. In the case of inflammation, the white blood-corpuscles have conquered the invaders and resisted further progress; while in suppuration the invading infection destroys whole fields of vital tissue, leaving focuses of local death—necrosis. The

pus formed by these infections through the gut wall may be safely evacuated by way of the alimentary canal. But frequently fatal issues follow either rapidly or through long exhausting processes.

The sympathetic pathological course which abdominal tumors induce in women are: (1) irritation, (2) indigestion, (3) malnutrition, (4) anemia, and (5) neurosis. The irritation passes by reflex action to the digestive tract (including the liver and pancreas). The irritation destroys in the digestive tract (a) the rhythm of the liver, pancreas and alimentary canal by emitting irregular forces over the plexuses at irregular periods (the reflex action has no regard for rhythm); (b) the irritation produced by the tumor on the canal destroys its motion; (c) it destroys its sensation; (d) it destroys its normal secretion.

Indigestion is a natural result of imperfect rhythm, motion, sensation and secretion of the alimentary canal. Long continued indigestion results in malnutrition; which finally ends in anemia. In anemia the fluid tissue known as blood is proportionately deficient in its constituents, and the innumerable nerve ganglia being bathed in waste-laden and impoverished blood, the woman is finally reduced to an irritable condition, or neurosis.

One of the strange features of abdominal tumors with long pedicles is that so few rotate on their axes. In autopsies I have noted the spleen resting on the pelvic floor with a long, narrow pedicle, but no symptoms of rotation. Dr. Lucy Waite and I have removed tumors with astonishingly long and thin pedicles with no symptoms of present or past axial rotation. Dr. Orville MacKellar and I removed an ovarian tumor about the size of a year-old child's head with a thin pedicle about eight inches long, with no symptoms of past or present rotation. We could push the tumor all over the abdomen from the pelvic floor to the diaphragm. We observed the long-pedicled tumor roll about among the loose intestines after opening the abdomen, and wondered why its pedicle did not twist.

However, I have removed tumors which had no pedicle. They had been twisted off their pedicle by axial rotation

and had assumed new beds, which were nourished by the newly formed vessels from adjacent viscera and tissue. It is a significant fact, noted by all practical gynecologists, that when a woman acquires a tumor, it may only be organized, she will frequently fret and chafe under it until she becomes nervous and irritable and her coolness and quiet serenity leave her. She also tires easily and does not sleep well.

Such a case came to me a few days ago, from whom Dr. Lucy Waite and I removed an orange-sized ovarian tumor per vaginam. This lady I treated seventeen years ago, when she was a blooming, vivacious girl. Some ten months ago she began to complain of ill-defined symptoms. A general practitioner treated her a year ago and examined the pelvic organs, but failed to find the tumor. Finally, she and her husband decided to consult a gynecologist, and came to me. In eight to ten months, from the rotation of the tumor, her nervous system had lost its fine, even balance of former years. She slept poorly, was irritable, appetite was poor an' she was easily tired out and had lost all her old vivacity It was all due to reflex action from a large orange-sized pelvic tumor. The disturbance will disappear with the tumor.

Abdominal tumors should be removed on account of danger of axial rotation. The literature which takes note of a tumor rotating on its axis covers only about thirty years. Rokitansky, of Vienna, was among the first to call attention to the subject. The writer estimates from literature and observation that about 8 per cent. of ovarian and parovarian tumors rotate on their axis. In 1891 Mr. Tait told the writer that he had, up to date, sixty-two cases of rotated tumors. While a pupil of Mr. Tait for six months the writer saw four tumors rotated on their axes. Almost any abdominal or pelvic tumor may rotate on its axis. The writer has observed in an autopsy rotation of the cecum and ileum on each other three-quarters of a turn, but insufficient to obstruct the cecal current. Volvulus is only axial rotation of the sigmoid on the mesosigmoid. In the intestinal tract volvulus occurs in the sigmoid flexure in 60 per cent. of cases; in 30 per cent. at the cecum, and in 10 per cent. in the small intestine. Axial rotation of the digestive

tract constitutes about 4 per cent. of all intestinal obstructions. It is no doubt due to a fatless, elongated mesentery (enteroptosis) and previous constipation. As regards the causes of axial rotation of abdominal tumors, the writer is convinced that it is due to visceral rhythm.

Any viscus which possesses an elongated attachment may rotate more or less on its axis. The uterus has been found rotated so as to demand operation. My assistant, Dr. A. Zetlitz, operated on a patient in whom the uterus was found with almost a full rotation, due to a contracting cicatrix from an old inflammatory attack. The kidney can, and does, rotate on its axis, resulting in partial or complete obstruction—the obstruction of its ureter causing hydronephrosis, and the obstruction of the renal vein due to twisting, interfering with circulation and nourishment. It is possible for the spleen, in certain abnormal conditions, to rotate on its axis. In one autopsy I found the spleen on the pelvic floor with a thin, partially rotated pedicle.

Axial rotation of abdominal tumors may be partial or complete, acute or chronic. An acute case generally acts in the following manner: A woman has an abdominal tumor. She has a sudden onset of pain; she will perhaps vomit. In twenty-four to forty-eight hours the abdomen will gradually enlarge. If it enlarges very extensively, the patient becomes pale and faint. The enlargement is the result of (a) the obstruction of the return venous flow from the tightness of the twist in the pedicle; (b) the dilatation of the veins in the tumor, and (c) the rupture of a vein in the tumor.

The rigid-walled artery is difficult to occlude, and so keeps pumping its stream of blood into the tumor. The soft-walled, easily compressible vein is quickly occluded by the twist in the pedicle, and so all, or nearly all, the blood pumped in by the artery is retained in the tumor. The consequence is a sudden abdominal enlargement. Of course a woman may bleed to death into her own tumor, and such cases are on record, confirmed by autopsy. The tumor may twist so much on its pedicle that it may occlude both vein and artery. It may rotate so vigorously that it will be entirely twisted off or severed from its connections. In such

cases the tumor acquires nourishment from the surrounding viscera. The trauma resulting from the axial rotation induces sufficient irritation to produce an exudate on the surface of the tumor. This exudate undergoes organization, acquiring blood-vessels, nerves and lymphatics sufficient to nourish the tumor without its old pedicle. The writer saw, with Mr. Tait, one tumor sufficiently rotated on its pedicle to occlude the vein and artery, which was nourished by innumerable delicate, newly-organized processes of viscera tissue.

In my own practice, while performing laparotomy, I have been surprised to find a dermoid ovarian tumor the size of a cocoanut entirely without a pedicle. It was wholly nourished by omental adhesions. The patient gave me a history of a severe attack four years previous, from which time pain and tenderness continuously clung to her. My attention was first called to axial rotation of tumors in 1884, at Heidelberg, in the clinic of Professor Czerny. One day a middle-aged lady suddenly appeared in the clinic who had come from her home in the country very sick. The professor put her on the table and examined her carefully. She had a high pulse and temperature and a dusky countenance. She appeared very ill. Professor Czerny said: "Gentlemen, I cannot make the diagnosis. I will examine her again and perhaps operate to-morrow." The writer anxiously waited until the next day, when, sure enough, the woman was put to sleep on the operating table. On opening the abdomen, a tumor the size of a melon appeared in the wound. It was dark-red in color, and Professor Czerny pronounced it gangrenous. It was easily removed and its pedicle ligated. That was a cyst rotated on its axis; and, besides, it was not gangrenous, as such tumors rarely become gangrenous in the abdomen, and, if washed well, will show the color of normal tissue. Gangrene generally comes from tapping such cysts, or the digestive tract may infect them. Cases have been frequently recorded where death followed tapping. Air entered the cyst and infection resulted.

Axial rotation of abdominal and pelvic tumors may pur-

sue a chronic or slow course. In such a tumor diagnosis is very difficult. The pain in such cases will be almost wholly carried by the sympathetic nerve, and pain due to irritation of the sympathetic is generally a dull, heavy ache. It is a dragging pain. Cerebro-spinal nerves induce sharp, lancinating pain. So that slow axial rotation of the abdominal tumors will be accompanied by dull, heavy, dragging pain. It may be noted that whenever there is more than one tumor in the abdomen the chances are very much increased for axial rotation. Pregnancy enhances axial rotation much more than the presence of a double tumor, because the uterus empties itself suddenly, and just after labor the tumor is apt to rotate. The writer has seen Mr. Tait operate on a woman six weeks after delivery for an abdominal tumor which rotated about three times and a half on its pedicle. She was quite ill from delivery until after the operation, when she rapidly recovered.

The strikingly easy manner in which operators speak of gangrenous tumors in the abdomen, with recovery, calls for objections. Recovery after gangrene or local death in the abdomen is extremely rare. What is usually called gangrene is simply tissue filled with venous blood. Now, if this dark tissue is removed and well washed, the gangrenous idea will be displaced by the frequent appearance of normal white tissue. Air must in some way get to a tumor to admit of gangrene, and air enters by (a) tapping, (b) digestive tract, (c) genito-urinary tract. If a cyst has rotated sufficiently to twist off its pedicle and become nourished by adhesions to adjacent viscera, it is more dangerous than the original tumor on account of its fixation and adhesions. It is generally more liable to infection from the natural channels, from its more extensive vascular connection. A tumor should be removed from its liability to axial rotation. A tumor rotated on its axis is dangerous to a patient from (a) hemorrhage into the cyst, (b) gangrene, (c) because it may unduly enlarge from filling the veins of the tumor, (d) it may become fixed by adhesions and thus endanger the viscera, a fixed tumor being more dangerous than a movable one, (e) it may become infected and suppu-

rate, (f) chronic axial rotation may exhaust a patient by pain, (g) it may result in trauma to viscera or perforation of viscera by pressure.

Abdominal tumors should be removed on account of the danger of rupture. It is a fact, which the writer has definitely observed, that tumors (ovarian and parovarian) will repeatedly rupture and fill in the living woman. In one case under my care the parovarian cyst repeatedly ruptured and filled during a year's personal observation. At the time of rupture the young woman of twenty-four would experience a sense of relief. The abdomen would become flattened and during a few succeeding days she would urinate frequently and profusely. Three years previously the writer had demonstrated that if a dog's peritoneal cavity was filled with water he would urinate profusely for two or three days. In removing ovarian tumors the writer has found old scars where such cysts had ruptured and refilled. The rupture may be due to violence or the continued pressure on some point of the tumor, thinning its walls so that leakage occurs.

Arupture of non-infected cyst does no harm to a woman, but when a cyst containing infected material ruptures in the abdominal cavity death is almost inevitable. Hence, such tumors which menace life should be removed on discovery. Cystic abdominal tumors are apt to rupture from increase of abdominal pressure, which, being sustained for a long time on single points of the cyst, either thin its walls so that they will leak, or rupture them by any violence. In one case the writer removed an ovarian tumor which gave a distinct history of rupture one year previous. A distinct scar about the size of a fifty-cent piece was found on the cyst to tell the story of rupture. Abdominal tumors may endanger life by rupturing into hollow viscera, as the gut, bladder or vagina. From such rupture infection is almost sure to follow. The worst infection follows rupture into the digestive tract, and second into the bladder. The writer has removed ovarian tumors with success which had ruptured into the digestive tract and almost destroyed the patient by chronic suppuration and exhaustion. About the worst of such tumors are ovarian dermoids, which rupture

Figure 9.

(From author's life-size chart of the sympathetic.) Represents the abdominal brain and adjacent ganglia; 55, a ganglion of the dorsal lateral chain; 61, splanchnic; 96 and 97, rami communicantes; 67, branches of right vagus to stomach; 69, trunk of right vagus entering abdominal brain; 70, phrenic nerve on phrenic artery; 71, right abdominal brain; 72, left abdominal brain; 73, gastric artery; 74, splenic artery; 75, hepatic artery; 76, right great splanchnic; 77, ad-renal; 79, supra-renal nerves (6); 82, inferior renal ganglion; 83, superior renal ganglion; 84, 85, 86 and 87, ganglia on renal artery; 88, renal artery; 89, 90 and 91, lumbar nerves; 96, 97 and 98, rami communicantes; 101, 102 and 103, lumbar lateral chain of ganglia; 106, sup. mesenteric artery surrounded by the abdominal brain; 107, 108 and 109, genital ganglia; 110 and 111, genital ganglia (ovarian), as well as 112, 113 and 114, genito-rectal ganglia; 167, nerves around the ovarian artery; 171, first lumbar nerve; 172, second; 173, third; 176, first, 177, second, and 178, third lumbar ganglia; 182, genital ganglion; 183, inferior mesenteric artery; 185, aortic branch of abdominal brain; 186, ending of left great splanchnic in abdominal brain; 187, superior, and 188, inferior (left) renal ganglia; 189, 190 and 191, (left) renal ganglia.

into the sigmoid or rectum, for they make such dangerous adhesions. The two cysts may press so hard and long against each other that the walls in contact will fuse and the rupture will occur in the fused septum, which complicates by more adhesions and size of tumor.

The pressure occasioned by abdominal tumors demands their removal. A tumor pressing for a long time against a gut wall may thin it so that germs or their products may pass into the tumor and infect it. Inflammation follows and may be accompanied by suppuration. But pressure must be observed to take place in two directions, viz., toward the tumor and toward the viscus. The damage from pressure in the abdominal tumors is threefold: (a) the effect of pressure on viscera; (b) the effect of pressure on the tumor, and (c) the effect of the pressure on the function of viscera, both remote and distant. This last idea was discussed under reflex action. It was shown how abdominal tumors induced hydronephrosis by partial or complete occlusion of the ureters. Tumor pressure will even induce interstitial and parenchymatous nephritis. Three-fourths of women long possessing abdominal tumors have kidney disease. The tumor may press on some segment of the digestive tract and induce obstruction of the fecal current, either mechanically or by reflex paralysis. The main point of pressure is on some fixed portion of the gut, the rectum, sigmoid or colon.

The canals, ureter or gut, curiously maintain their potency for a long time on account of their continual dilatation and contraction. The writer has seen these canals entirely surrounded by dense tissues of tumors, but a distinct tunnel still existed through the tumor, considerably larger than the empty collapsed canal. The abdominal tumors, in a word, by pressure induce obstruction, mechanically or by reflex irritation (spasm or paralysis), and should be removed. The continued pressure gives rise to (a) inflammation, by allowing infection to travel; (b) the inflammation may go on to suppuration and end in perforation, internally or externally.

The effect of pressure on the circulation (vascularity) is very apparent. It acts mainly, or the effect is more evident, on the great venous plexuses. The hemorrhoidal from

the inferior mesenteric suffers the most, as many of such patients have hemorrhoids. The effect of the pressure on the plexus pampiniformis is also plain, as also on the vaginal plexus and the venous bulb of the vulva. Areas of tissue become œdematous. The limbs swell. The pelvic organs suffer the main brunt from mechanical pressure, while distant organs evidently suffer most from reflex action. The effect of mechanical pressure on circulation is (a) congestion, (b) œdema, (c) dilation of veins (hemorrhoids). It must not be forgotten that since the sympathetic is mainly distributed to blood-vessels the reflexes from pressure on the vessels are effective and profound, local and general.

The writer has noted the effect of tumors on the color of the skin for a long time. It has been recognized that pigmentation arises mainly from the spleen. Jastrowitz started the view that the spleen was the source of pigmentation, by dividing the sympathetic plexus going to the spleen on the spiral splenic artery. This experiment enhanced pigmentation. No doubt the liver is a second source of pigment, from the fact that it buries red corpuscles, and pigmentation is very noticeable in malaria which profoundly affects the liver (and spleen also). But still the spleen may be credited with the main origin of pigmentation. The writer has noted about all colors of pigmentation (brown, black and yellow) in such women, especially in a woman who has had a tumor a long time. The author saw a woman last month who had had a tumor for sixteen years. Her color was a deep brown and yellow, with patches of atrophied, glistening skin interspersed. The tumor disturbs the rhythm of the spleen. The spleen is capable of a rhythm by (a) its elastic covering of peritoneum, (b) its elastic capsule, (c) by the power of its cells to enlarge on receiving excessive blood. When the tumor irritates the splenic plexus it destroys its rhythm, and hence its nourishment. The nourishment being disturbed, the distribution of its products—pigment—will be disturbed. Irritation induces the spleen to produce excess of pigment. The parts of the body most intensely pigmented are those exposed to air. Yet the pigmentation is general. The sim-

plest example of pigmentation is observed in pregnancy, which is generally localized in the genitals, breasts and linea alba.

But abdominal tumors create more definite and general pigmentation. The pigmentation is effected by the irritation passing to the abdominal brain, where it is reorganized and emitted to the spleen.

The irregular forces coming at irregular intervals to the spleen derange its rhythm, and consequently its nourishment. Pigmentation is the result of a silent process accomplished by reflex irritation, and shows general derangement of the visceral economy. It is merely the outward manifestation of profound processes, indicating removal of the offending invader. It is difficult to convince physicians that a laparotomy is really demanded to remove adhesions. Adhesive bands have blood-vessels, lymphatics and nerves.

A tumor should be removed because of its danger to create adhesions, but after they have formed they often require removal. They should be removed when they give rise to pain, when they distort and unbalance the viscera. They may occasion obstruction to any hollow viscus. They may strangulate some viscus.

Even the lungs do not escape the evil influence of the presence of the abdominal tumor. The disturbance in the lung is mainly due to reflex irritation which disturbs the rhythm of the lungs.

Abdominal tumors should be removed, from their liability to become infected.

The question may be asked, How does an abdominal tumor become infected or inflamed? Tumors frequently become infected, as is easily attested at the operation, by observing adhesions—the result of infection.

The great highway by which abdominal tumors become infected is through the Fallopian tubes. Any laparotomist can easily see that inflammatory exudates arise at the fimbriated ends of the tubes, and from there spread. The infection travels by natural routes, especially along mucous channels. It travels particularly through the left Fallopian

tube, as the writer demonstrated that the lumen of the left tube is larger than that of the right.

The second great highway of infection of abdominal tumors is through the digestive tract. Germs or their products pass through the gut wall at pressure points and infect the tumor.

The third channel of infection is through the genito-urinary tract. A fourth is by tapping, allowing air to enter. The table presented with this article will show at a glance the reasons for removing abdominal tumors:

EFFECTS AND CONSIDERATIONS FOR THE REMOVAL OF ABDOMINAL PELVIC TUMORS.

Heart—

1. Irregularity.
2. Hypertrophy.
3. Fatty degeneration.

Lungs—

1. Disturbed rhythm—asthma.
2. Catarrh—anemic, hyperemic.

Liver—

1. Disturbed rhythm. (a) Too much secretion.
2. Disturbed secretion. (b) Too little secretion.
3. Pigmentation. (c) Disproportionate secretion.
4. Nerve influence can check all secretion.

Kidney—

1. Nerve impression can check all secretion.
   (a) Too much secretion.
   (b) Too little secretion.
   (c) Disproportionate secretion.
2. Reflex irritation.
3. Obstruction (hydronephrosis).
4. Infection. (a) Parenchymatous inflammation.
   (b) Interstitial inflammation.

Digestive Tract—

1. Sensation.
2. Motion.
3. Secretion.
   (a) Too much secretion.
   (b) Too little secretion.
   (c) Disproportionate secretion.
4. Pressure.
   (a) Inflammation.
   (b) Suppuration.
   (c) Perforation.
   (d) Adhesions.

Spleen—

1. Disturbed rhythm.
2. Pigmentation.

Bladder—

1. Pressure.
2. Perforation.
3. Cystitis.

Inflammation—

1. Through Fallopian tube.
2. Digestive tract.
3. Genito-urinary tract.
4. By tapping.

Circulation—

1. Congestion.
2. Œdema.
3. Hemorrhoids.

Suppuration—

1. Infection.
2. Fistula.
3. Adhesions peritoneal.

SYMPTOMS.

Axial Rotation—

1. Due to visceral rhythm.
2. Ten per cent. of ovarian and parovarian tumors rotate.
3. Pregnancy and other tumors enhance axial rotation.
4. Diagnosticated by sudden pain and increase in size of abdomen.

Rupture—
1. Sudden changes in form of abdomen.
2. Diuresis.
3. Diarrhea.
4. Cystitis.

Pressure—
1. Inflammation.
2. Infection.
3. Perforation.
4. Hydronephrosis.
5. Obstruction.
6. Œdema.

Adhesions—
1. Induce pain.
2. Check peristalsis.
3. Cause reflex rhythm.
4. Disturb secretion.

CHAPTER VIII.

SHOCK.

"Man ages rapidly on the battlefield."—*Napoleon.*

"It is easy to see—hard to foresee."—*Benjamin Franklin.*

Here I wish to say a few words in regard to shock. I shall consider shock a profound impression on the sympathetic nerves. It is manifested by derangement of the abdominal brain and its automatic visceral ganglia. The physician who is distinctly impressed with shock is the abdominal surgeon. He sees shock in all its grades from the slight evanescent condition to that profound danger "shock," to recover from which requires a couple or three days. Experiments on dogs, manipulating their viscera and operating on the same, produce shock in all its manifestations. Few physicians will believe the wide nature of shock, or of a profoundly depressed sympathetic system. For example, in the clinic of Professor Senn a few weeks ago there occurred the most impressive effect of reflex action through the sympathetic nervous system. A young man came into the hospital on account of some kind of swelling on the right side. He was very ill. In the meantime Dr. Senn was about to operate, but just before he began the patient suddenly passed several ounces of urine. He had been passing a small quantity before. The sudden gush of several ounces passed away, and the swelling in the right side went down.

In a few days the swelling returned on the right side and the man passed no urine at all for sixty hours. He became so low that Dr. Senn operated with cocaine injection—no general anesthetic. He removed from the kidney on the right where the swelling was, a stone with a conical point on it, which had dropped intto the mouth of the ureter and obstructed the flow of the urine. The reason of the sud-

den flow of urine was because the kidney pelvis expanded during the increase of the hydronephrosis and the conical point of the stone dropped out of the ureteral mouth, relieving the obstruction. Now, the interesting part of the case is that after the removal of the stone both kidneys began to secrete equal quantities, the one on the right which was incised and the left. But while the right kidney was swelling for sixty hours the left did not secrete. It was due to reflex action transmitted through the abdominal brain. It may be remembered that the renal ganglia are very large and closely connected with the abdominal brain.

Now, reflex nerve action is in the nature of shock. It is simply injury or incisions which act as such to nerve mechanism. This case, many of nature similar to which could be quoted, as injury to testicles resulting in vomiting and bowel obstruction, is very instructive, for if the irritation of a stone in one kidney so shocks the other that it will not secrete urine from reflex action, what a disturbing effect one inflamed viscus must exert over all others through the years.

For inflammation may be looked on as a shock to the nerve periphery of the concerned organ. What a profound shock a large, heavy, metritic uterus, or, it may be, the pinched nerves of an atrophic uterus, produces on a patient during five to ten years! ! ! I have seen metritic uteri so shock the system by reflex action that the patients are simply neurotics in three to five years. The continued shock of inflamed visceral ganglia on the abdominal brain deranges the whole organic life. Shock is manifested through the sympathetic system. Shock, so far as I am able to understand it, is due to excessive irritation of the sympathetic nerves. The above case in regard to the kidney showed that irritation of a stone in one kidney forced the other kidney to stop secreting. Introducing a catheter into a male urethra or a sound into a uterus will often cause such a nerve storm in the sympathetic that the patient will show a high grade of shock. It is excessive irritation of the sympathetic nerves which intensely supply the genitals. Crushing or injuring the testicle causes vomiting and profound shock. A

blow on the stomach (abdominal brain) quickly induces shock.

In fact the abdominal brain is so intimately connected with the large blood-vessels and viscera that injury or trauma to any of them irritates the sympathetic nerves, and if the irritation be excessive the result will be shock in proportion to the irritation. Secretions diminish in shock and they are controlled by the sympathetic nerves. Those organs which the sympathetic nerve supplies tend to perform rhythm, and shock is what disturbs rhythm. Slight stimulation of sympathetically supplied organs increases their rhythm and strengthens their vigor, but let the stimulation be excessive and shock in some grade arises. The origin of shock may be cerebro-spinal or in the sympathetic system. For example, shock can arise mentally, as is witnessed by cardiac palpitation, involuntary bladder and rectal evacuations. Fright pales persons and induces palpitation.

But the manifestation of shock is from organs supplied by the sympathetic nerve, i. e., the thoracic and abdominal viscera. Of course shock is closely and intimately connected with the vascular system as the center, and the sympathetic, vaso-motor, controls that. It must be said over and over for the sake of non-believers that the sympathetic system and cerebro-spinal system have different functions to perform, but they are mutually independent. They both to some extent supply the same viscera, but the sympathetic preponderates for it holds its rhythm. Dr.W. A. Peterson, of Elgin, Nebraska, has just reported to me a case where the cerebrum, cerebellum, and even medulla oblongata, were absent, yet the child was well developed and nourished and lived a short time after delivery.

The sympathetic system keeps the chemical laboratory of the body in action. It controls circulation and nourishment. It holds secretion and rhythm. It has to do with organic life. A good example may be employed to note what is manifest, excessive irritation of the sympathetic nerve, and early in my obstetrical career I ignorantly experimented on labor cases. Attend a labor when the pains may be dilatory or slow, as some pa-

tients are. The uterus passes through a typical rhythm and it is so slow that it is easily studied. Its mechanism is so perfect and beautiful, that one does not wonder that the old obstetrician said labor came on by the "Grace of God." The nicely balanced nerve mechanism is hard to see. But now let us give ergot continually for some hours and we will note that the uterus loses its beautiful and stately rhythm. It begins to be vigorous and even violent and in a short time under the dangerous ergot the uterus assumes almost a tonic contraction. It has lost its swinging rhythm of rest and activity and assumed an action of irregular violence. It is on the road to shock. In short its sympathetic nerves the exceedingly irritated. Shock is not paresis and dilatation of vessels.

Another good example of shock can be illustrated by excessive electric irritation of the viscera. Electricity applied to the small intestines will produce such vigorous muscular contraction that the seat of application will be represented by a white ring reaching entirely around the gut.

From various views and experiments we are induced to consider shock as an excessive irritation of the sympathetic nerves. I think, for example, that I have often counteracted shock in abdominal section by giving 1-16 of a grain of morphine hypodermically. Of course moist heat is superior to all other remedies. The heat acts as a sudden stimulant to the small vessels in the skin and contracts them, but the heat being continued the vessels soon relax and sweating follows with relief. The system resists shock the more nearly normal it is. In abdominal section we try to avoid shock by rendering the whole system as near normal as possible. For example, all organs are at their best tone and strength when actively secreting. In the preparation for laparotomy four or five days are required to place the intestinal glands in their highest function by physics, the kidneys by diuretics, and the skin by salt baths and friction. In shock we must attempt to quiet the excessively irritated sympathetic system.

CHAPTER IX.

THE ABDOMINAL BRAIN AND AUTOMATIC VISCERAL GANGLIA.

Instinct is a propensity prior to experience and independent of instruction."—*Paley*.

The Intimate and Profound Connection of the Genito-Urinary Organs with the Sympathetic (and Cerebro-Spinal) nervous system.

Its Connection with the Rectum and Relation to Coition.

The Relation of the Pelvic Organs to the Larynx (voice); the Fifth (Ganglionic) Cranial Nerve, Stomach and Eyes.

Automatic Menstrual Ganglia.

The Menopause.

Every observing physician sees a close connection between the genital organs and the nervous system. This is not strange when one considers existing conditions and the long-continued effect of evolutionary forces. Of all the instincts in the animal race, the sexual instinct is dominant. This instinct has an all-pervading influence in every species of animal. It governs their action. It forms habits in their lives. It induces new phases of existence. All through the stages of animal evolution, every other instinct must bend to the sexual. Physical and mental forces wonderfully combine to make this instinct the most effectual in its consummation. The sexual instinct dominates most powerfully the males, and hence the physical and mental vigor of the best animals in the race survive. The cow in rut is served, from sheer physical and mental vigor, by the most powerful bull. In herds of animals the sexual instinct dominates most vigorously in the finest males, and the weak males are cast aside that the strong ones may become the parents.

The main study of zoology is reproduction. The weapons of offense and defense possessed by males are primarily

to cultivate and defend the sexual instinct. The horns of bulls, the powerful heels of stallions, the eagle's talons, and the claws of powerful feet, are the weapons to defend and to carefully cultivate this dominant instinct of animal life. When we pass on to man, the sexual instinct is rather heightened than diminished. But in man it is more subtle; secretly in the depths of man's mental forces lies his sexual instinct. As he has gained the ascendency in animal life by his mental activities, in this light alone can be studied his sexual instincts. Thus in the lowest form of physical existence sexual instincts dominate, yet in the higher forms of mental existence these instincts are still more powerful.

From such premises, patent to all observers, it is quite obvious that evolutionary forces have through long ages established a very close connection between the nervous system and the genitals—the organs which gratify the sexual instinct. Forces (mental or physical) acting through eons of ages establish definite results. The increase of man's intelligence is not in proportion to the increase of ganglion cells, but by the increase of conducting cords. Chicago and New York may each represent a ganglion cell, and a single railroad may represent the conducting cord. Now when there was but one railroad between New York and Chicago, little business could be done on account of the limited amount of commerce which the single road would accommodate. Chicago and New York, as the ganglia cells, could dispose of far more business than the single road would transmit. But when the railroads multiplied between the two centers, the business increased just in proportion to the number of roads or conducting lines. Now, ages of natural forces have established numerous lines, and vigorous lines, of connection between the genitals and the nervous system. The facts which dissection show are positive in demonstrating the widespread and intimate connection of the genitals with the cerebro-spinal and sympathetic system.

The ganglion cells can receive and dispose of far more mental work than a few conducting cords can transmit; so that the progress and advance toward a higher nervous sys-

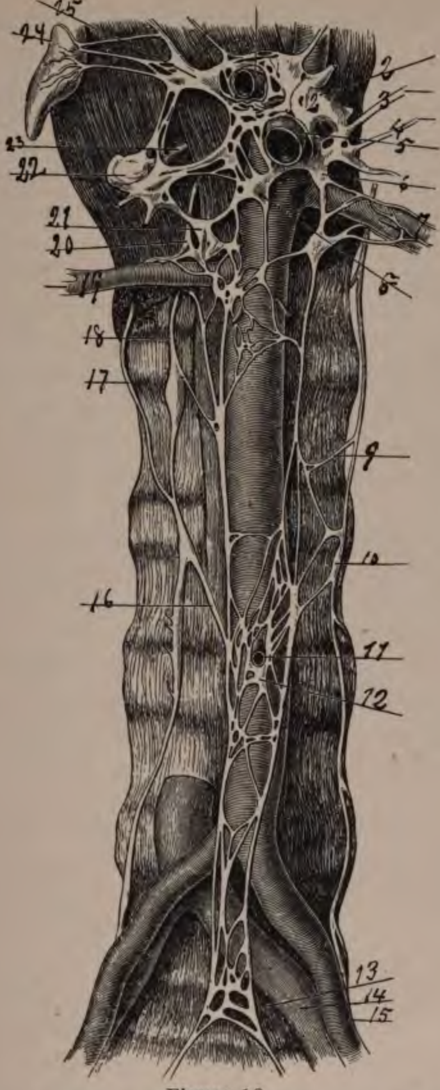

Figure 10.

(Jacob Henle). Represents the abdominal brain, the lumbar lateral chain, the inferior mesenterico-ganglion and the hypogastric plexus; 2, abdominal brain; 3, great splanchnic; 4, small splanchnic; 5, superior mesenteric artery; 6, renal ganglion; 7, renal artery with its ganglionic plexus surrounding it; 8, superior mesenteric ganglion; 9, ramus communicans; 10, lumbar lateral chain; 11, inferior mesenteric artery surrounded by its plexus; 12, 13, sacra-iliac point; 14, innominate vein; 15, innominate artery, to the right of which courses the hypogastric plexus; 16, ramus communicans to inferior mesenteric ganglion; 17, ramus communicans; 18, lateral chain; 19, right renal artery; 20, splanchnic minor; 21, renal ganglion; 22, splanchnic ganglion; 23, splanchnic major; 24, ad-renal; 25, ganglion phrenicum.

gluteus-maximus muscle and the external genitals by means of the pudendal nerve or branch of the lesser sciatic. The gluteus maximus is the real muscle that holds man upright (physically), but it is also the main muscle of coition. The lesser sciatic nerve supplies only one muscle, and that is the gluteus maximus, and then sends off the large pudendal branch to the sides of the penis, and hence the friction of coition induces active contractions of the gluteus maximus. The spinal-nerve supply to the external genitals is mainly the large pudic and pudendal nerves. In woman the pudic nerve is equally large; but the pudendal nerve is much smaller in woman than in man, according to my dissections. The lesser size of the pudendal nerve in woman is in direct accord with the methods of cohabitation. The vigorous and aggressive activity of man in coition, and the quiet, passive receptivity of woman, explains the larger pudendal nerve in man. But the reverse nerve supply arises in regard to the glans clitoridis and the glans penis. I have dissected many a clitoris, and its nerve supply is three or four times as large as that of the penis in proportion to its size. The clitoris is a veritable electrical bell, which, when irritated, rings up the whole nervous system. There is no doubt that adhesions of the prepuce to the clitoris have led to masturbation in girls. Every gynecologist should examine the clitoris, and, if preputial adhesions exist, simply break them up, for the vast nerve supply of the clitoris gives great chances for profound irritation. The poor girl, neglected by the mother and possibly by the doctor, is soon induced to become a masturbator.

But the extensive spinal-nerve supply to the external genitals, though vast and intimate, is but a small matter relative to the supply to the internal genitals. The spinal-nerve supply to the external genitals is mainly sensitive, so that the sexual instinct may be gratified by the organs. What I wish mainly is to call attention to the profound connection of the internal genitals with the nervous system by means of the sympathetic system. It is in this field that the gynecologist and the genito-urinary surgeon find full play for lucrative operations—for so-called aggressive

surgery. In manipulations and instrumental examinations of the genitals one sees the nerve storms flash over the system. These nerve storms radiate over distant nerve plexuses like electricity over a system of wires. Take, for example, the uterus. Its sympathetic nerve supply is enormous. The cervix only, so far as I can see, has spinal nerves, while the body and fundus are supplied by the sympathetic. One can count some twenty or thirty strands of nerves in the hypogastric plexus which originate in the abdominal brain and terminate in the uterus, and the nerves are very large. The ovarian plexus—a very large plexus—goes from the abdominal brain, and many of the nerves of this plexus terminate on the tubes and fundus of the uterus, so that the sympathetic nerve supply to the uterus is enormous. A large nerve supply to any organ subjects it to the danger of sad complications and stubborn pathology. I have seen a patient in the gynecological chair make active efforts to vomit in less than fifteen seconds after careful introduction of the sound. In those few seconds a complicated nervous phenomenon had occurred. The irritation of the endometrium had been flashed up the hypogastric plexus to the abdominal brain, and there it was reorganized and dashed over the various plexuses to other viscera.

The irritation, no doubt, went to every viscus similarly, but the stomach manifested itself in motion (vomiting). The heart, lungs, liver, spleen and digestive organs no doubt suffered similarly, but they were better able to resist the irritation. A study of the hypogastric plexus and its action on the uterus convinces me that pressure on the aorta for post-partum hemorrhage is generally explained wrongly. It is said the pressure obstructs the blood, but in reality the pressure on the hypogastric plexus irritates the peripheral ends in the uterus, and induces it to contract.

This is more reasonable. The dominating influence of uterine disease is due to the vast and intimate connection of the uterus (tubes and ovary) with the sympathetic nervous system. Besides, a great and complicated network of nerves is easily deranged. The importance of the uterus demands a

vast and complicated nerve supply. It may be laid down as a general proposition that the viscera have their normal function in rhythm, and the disturbance of the rhythm induces disease. The main pathology of the sympathetic is reflex action from some distant viscus.

The ganglia controlling the viscera are entirely out of the control of the will. If the visceral movement was not involuntary or out of the mental sphere men would speculate and experiment on their viscera. This fact no doubt explains the curious action of neurotic women. The nerve storms which emanate from a pathological uterus flash over the whole system by distinct nerve plexuses, and, as the will does not control any of such reflexes, the patient acts on the induced feelings. The close nervous connection of the uterus with the nervous system is at once seen in the great changes which uterine disease induces in both the mental and physical life of a woman. But anatomical facts, physiological experiment, and clinical study all show that the genitals and nervous system are more highly and intimately connected than any other system. No organ influences a woman mentally or physically to such a degree as the uterus—the autocrat of menstrual life—even in its normal physiological and anatomical condition, while its pathological condition is still more manifest. It is owing to the very distinct connection of the genitals with the cerebro-spinal and sympathetic system. Let a woman's genitals become pathological and she acquires liver disease and indigestion, and becomes anemic and neurotic. Uterine disease also induces eye disease and heart trouble, and the joints and muscles do not escape. Pelvic diseases are often accompanied with hip, knee or ankle trouble. This is no doubt due to the intimate connection of the uterus with these joints through the sacral plexus; e. g., the sacro-iliac joint, the hip joint, and the knee joint are all supplied by three distinct nerves—the great sciatic, the anterior crural, and the obturator. Now, these three nerves are really the sacral plexus. A cold contracted at the monthly period from wet feet is explained no doubt by close connection of the uterus with the sacral plexus, for the lower end of

the sacral (the sciatic nerve) supplies the feet. The disturbed circulation in women afflicted with uterine disease is owing to the powerful reflexes sent over the great hypogastric plexus, and the normal rhythmical contractions of the heart and its blood vessels are broken by reflexes due to uterine disease.

But it is not the woman only who is afflicted with reflexes from the genitals. The genito-urinary surgeon who deals with men afflicted with urethral disease knows the effect often of the mere introduction of a sound into the bladder. A healthy man will frequently faint from the introduction of a sound, and if the urethra or genitals are long diseased he will be profoundly shocked. This means that the urethra is extraordinarily supplied with nerves. I do not see, so far, any better explanation of so-called urinary fever after the introduction of a catheter than that it is "reflex." The urethral irritation may travel in two ways and act in two ways: 1. It may travel up the spinal cord to the heat center either by the sacral plexus through the cord or by the splanchnics through the cord and thus disturb the heat center. 2. But more probably the urethral irritation is transmitted up the hypogastric plexus to the abdominal brain and there reorganized and sent out on the various plexuses.

But it goes out on the renal plexus more vigorously owing to the more intimate connection existing between the kidney and the genitals—e. g., the ureter has a plexus, the testicle has a plexus, and also a part of the hypogastric plexus forms part of the renal plexus; and also originally the kidney and genitals arose from the same body—the Wolffian.

Now, the reflex irritation induced by the catheter on the urethra then flashes up the hypogastric plexus, and the reorganized forces are sent to the kidney and the irritation acts on the kidney to change its circulation—it is congested and urinary fever follows. The fainting of patients on the introduction of a catheter is explained on the same principle. The high nerve supply to the urethra being disturbed, the irritation is transmitted to the abdominal brain, where it is reorganized. The reorganized forces are then

radiated out on the various sympathetic splanchnics up to their three nerves to the heart, which it induces to move as organized in the three cervical ganglia and transmitted by their three nerves to the heart, which it induces to move in a riotous manner. The heart is weakened and the patient faints. The irritation of the genitals being sent to the abdominal brain, it induces dilatation of the abdominal visceral circulation, and this probably explains the rise of temperature. Occasionally the introduction of a sound kills a patient, but that may be due to the weakness of the patient after a long-continued exhausting disease. Thus the nerve storms arising from the genitals are entirely due to the abundant and exhaustive nerve supply. The irregular nerve storms arising in genitals highly supplied by nerves are profound in their invasion of the whole system. They pervade all active organs and disturb rhythm and induce further reflexes. Reflex action from the sympathetic explains much—e. g., when a man begins the "catheter life" he rings his own death knell; by the use of the catheter he induces reflexes which will remorselessly follow him until death. Besides, he introduces infection into the urethra and kidneys by the dirty catheter.

Thus the man goes through three stages on his road to the grave: 1. He has acquired some form of obstruction to the outflow of urine from kidney to penis. 2. He introduces the catheter, which calls up the wide domain of reflexes. 3. He introduces infection, and death follows. If the genitals were not so highly supplied by nerves, the terrible reflexes would not arise. As an application of the extensive supply of sympathetic nerves to the genitals and its wonderful reflexes, examine for a moment the result of coition.

The role played by the vaso-motor centers should not be lost sight of. I have found, time after time, that the ganglia of the lateral chain of the sympathetic, situated at the root of the pudic (third sacral), were very large, and this will aid in transmission of irritation.

Conclusions.—1. The sexual instinct is the most dominant instinct of animals.

2. Evolutionary forces have linked the abdominal sympathetic nervous system and the genitals by numerous and intimate bands which increase with the progress of higher development—i. e., sexual instincts dominate and influence man as well as the monkey and the ape, far more than the lower grades of animals.

3. By reason of the growing and increasing intimate relations between the genitals and the nervous system, mental forces play a greater role in the production of disease.

4. I have observed that the monkey is an inveterate masturbator in confinement, and his persistent attention to the genitals shows that the sexual instincts keep pace with mental progress.

5. The severe shock arising from hysterectomy shows that the uterus has an extensive nervous connection with the abdominal brain. In this operation one cuts off the great hypogastric plexus, and I have seen an alarming rise of temperature (103°), disturbed respiration and circulation, all from cutting the hypogastric plexus. The disturbance was not due to infection, as almost all of it arose a few hours after the operations. Occasionally taking out the appendages shocks, but, as the ovarian plexus is small, the shock is limited.

6. The genital and the urinary organs both arise from the Wolffian body, so they are anatomically and physiologically connected, and both have an enormous nerve supply, so that damage to one often injures the other by reflex —e. g., hysterectomy has caused death by inducing nephritis a few days succeeding the operation, the test tube revealing three-quarters albumin under the heat test.

7. The close connection between the genitals and nerve system is clearly seen from the terrible nerve storms which flash over the system from irritation (manual, instrumental or pathological) of the genitals—e. g., irritation of the clitoris quickly disturbs the whole nerve balance.

8. The great nerve connection of genitals and centers indicates that all irritation should be at once removed. All preputial adhesions on the clitoris should be broken up, and the same with those of the prepuce. In short, all

pathological conditions of the genitals should be at once righted, so that the nerve balance may be maintained.

The reports of fainting and vomiting and even death during coition have a scientific interest in view of the present subject. The celebrated Russian general, Skobeleff, died while cohabiting with an ill-fame woman. Attila, king of the Huns, died while holding sexual relations with his young wife. In a small town in Ohio, a man nearly 70 years of age was reported to have died during coition. Stock men have made interesting reports in regard to animals. A mare put to a stallion fell dead at the end of coition. Young male animals have often fainted when first allowed to serve the female. The dog coition is prolonged, which limits shock. A dog has no semen sacs. The boar has an intensely violent coition, with consequent effect on his viscera, as in respiration and circulation. Young stallions are the most liable to faint of any of the domestic animals. Young bulls become weak, exhausted and tremble at first coition. A medical acquaintance related to me a death in a middle-aged man about an hour after coition.

Dr. Miller related two instances which interested him very much because he did not understand the explanation. A man about 60 years of age, while walking to the door a few minutes after cohabiting with a strange woman, fell and died immediately. In another case, at the first coition the young husband fainted, and the sphincters relaxed, defecation and urination resulting. One can easily observe in domestic animals that, especially in the male, the respiratory rhythm is disturbed—slowed for a while and then quickened. The heart will also be disturbed in its rhythm—slowed for a time and then quickened. The explanation of these phenomena lies in the sympathetic ganglionic system. The vesiculæ seminales are very highly supplied by the hypogastric plexus of nerves. As soon as the irritation is produced on the nerves of the semen sacs, it is carried up to the abdominal brain. Then the irregular, stormy irritation accumulated in the abdominal brain is radiated out on the various plexuses of nerves, especially in the direction of least

resistance. The distribution of rhythm will be most manifest in that organ which is weakened or most sensitive.

We will consider first the sudden deaths which are due to rupture of blood-vessels in the brain. Such sudden deaths are apt to occur in elderly men who have weak arteries, and also the death is more liable to occur when the man is cohabiting with a strange woman for the first time, when he will be the most excited. Such deaths seldom occur with men who repeatedly cohabit with the same woman, when excitement is but ordinary. The explanation is, that the irritation goes from the semen sacs, during the spasm of expulsion, to the abdominal brain. Here the irritation is reorganized and radiated to the vaso-motor center. The irritation may also go up the spinal cord to this center. The disturbance in the vaso-motor center produces narrowing of the caliber of the peripheral blood-vessels and thus the blood-pressure is suddenly raised. At the same time the heart is slowed and hence the force is increased. It pumps the blood vigorously into the arteries and the weak wall gives way under the sudden pressure. The weak cerebral artery yields to the excessive blood-pressure, and death follows immediately from blood extravasation. It will be noted that all such deaths have occurred with elderly men who generally have weak, atheromatous arteries, with degenerated walls.

In cases of vomiting and fainting, the law is just the same. The irritation due to the emptying of the semen sacs is conveyed to the abdominal brain or up the spinal cord. The disturbed energies are reflected to the heart and stomach, and fainting and vomiting are apt to arise. It comes under the same law as vomiting in pregnancy. (In domestic animals, fainting, vomiting or death is liable to occur in those animals which have a short, intense orgasm, as the horse or pig. The orgasm is much more intense in males, and hence they are nearly always the subjects of disturbances during cohabitation. Females suffer very rarely. All this profound impression in the coition of animals is due to the irritation being sent to the abdominal brain, where it is reorganized and radiated out on the

plexuses of the various viscera. The sudden, short irritation deranges the normal rhythm, and hence the pathology of fainting and vomiting. The disturbance of rhythm will be the most manifest in that organ most sensitive or most essential to normal life. The same rules apply precisely to man.

Men during coition occasionally faint, vomit, defecate, urinate, or die. I know of a noted judge who died shortly after connection with a girl in a brothel. In Chicago, a short time ago, at one of the principal hotels, a man of probably forty-eight was found dying after cohabiting with a strange woman. All such deaths that I know or have read of have occurred in elderly men. The smaller manifestations, such as fainting, vomiting, urination, and defecation, have all occurred in quite young men—mainly at the first coition. The elderly men scarcely ever die while cohabiting with their wives, as they are familiar with them, and the excitement of the orgasm is not so violent or intense. It generally occurs with old men (in age, if not in years) in a first coition with a strange woman. Death may occur with an old man who has not had connection with his wife for a long period, especially if the orgasm is intense. I do not include in such a subject the rupture of some pelvic tumor, due to coition. The explanation of the matter lies in the sympathetic nerve and its reflexes. The irritation of the penis is due to friction, and of the semen sacs to spasm and evacuation, which is transmitted to the abdominal brain and there reorganized.

The accumulated irritation in the abdominal brain is radiated rapidly and on the various directions of least resistance. It rapidly ascends the splanchnics and is reorganized in the cervical ganglia and sent to the heart. The irritation sent so suddenly to the heart at first violently stimulates it to a vigorous action, so that the blood-pressure is raised to a high tension in the brain, especially in the left cerebral artery. Old men often have friable degenerated arteries, and this sudden rise of blood-pressure induces the middle (left) cerebral artery to rupture, and thus arises the death from coition. The primary cause is the

Figure 11.

(From author's life-size chart of the sympathetic). Represents the cervico-uterine ganglion; —, the pelvic brain; 127, second; 128, third, and 129, fourth sacral nerves (left); 131, second; 132, third; 133, fourth sacral nerves (right); note the connection of the second, third and fourth sacral nerves to the pelvic brain; 137 and 138, second and third sacral ganglia; 139, branches from the second sacral; 140, branches from the third and fourth sacral nerves to the pelvic brain (141 and 142.) The pelvic brain or cervico-uterine ganglion is marked 141, 142, 143, 144 and 145, branches of it, third sacral to the levator ani muscle (146); 147, vesical ganglion; 148, ureter; 149, bladder; 150, vagina; 151, uterus; 152, nerves of bladder; 153, vaginal ganglia; 154, uterine nerves; 155, rectal nerves; 156, rectum; 157, internal pudic nerve; 158, right, and 159, left sacral plexus; 160 branches of hypogastric plexus which do not enter pelvic brain before distribution; 161, Fallopian tube; 162, ovary; 163, round ligament; 164, acetabulum; 165, spine of ischium.

reflexes arising from the semen sacs and genitals. During the dissection of quite a number of cadavers, I have noticed that the connections of the lateral chain of sympathetic ganglia are very large at the root of the third sacral nerve. It must be remembered that the third sacral makes up nearly all of the pudic nerve; also that all the external genitals are supplied by the pudic nerve.

Hence, we find that the pudic nerve connects itself with one of the largest ganglia in the lateral chain of the pelvic sympathetic. Irritation of the external genitals is quickly carried to the vaso-motor center by the close and extensive connection of the cerebro-spinal sympathetic.

The rectum and anus have a close connection with the sympathetic nerve.

I have often noticed that in dilating the rectum under an anesthetic, the patient would utter a kind of hoarse bray, similar to the braying of an ass or mule. The mare in heat will often utter a similar sound. If the mare is watched, she will be seen to be disturbed occasionally, every five to eight minutes. When a "spell" or disturbance arrives, she will first raise the tail, and then begin to straddle and utter a kind of bray, then the vulva is spasmodically everted, followed by the emission of fluids from the vulvo-vaginal gland. The explanation of this phenomenon must be made through the pudic and sympathetic nerves of the rectum and genitals on the one hand, and the recurrent laryngeal and sympathetic on the other. In short, there is a distinct relation between the voice and the rectum. This connection must lie in the sympathetic nerve. If one dilates the rectum suddenly the patient's skin capillaries become flushed with blood and sweating is induced.

There is also an evident connection between pelvic disease and the voice. Menstruating women are apt to have tonsilitis more than non-menstruating women. Chronic irritation in the pelvic organs will induce chronic disease in the tonsils and throat. In some women the voice changes at menstruation or during aggravation of pelvic disease. Not uncommonly young women have difficulty in swallowing at menstrual times, and their hearing may be a little

disturbed, because the chronic inflammation travels up the Eustachian tube. The distant relation and connection between the ovary and parotid gland is well known, as in mumps and operations on the ovary. Few writers have called attention to the relation of pelvic disease to pharyngeal disturbances, which exist by means of the connection with the sympathetic. The relation of the tripod in exophthalmic goiter—heart, thyroid gland and eyeball—will be more readily understood through the study of the sympathetic nerve. The enlargement of the thyroid in the menstrual life of women rests on the sympathetic nerve. The sexual life of woman is her chief life, from a physical standpoint, and as she has a larger ganglionic system than man, she demands special study; for from this chief function of her life will arise new structures and diseases.

The anus is the last to become insensible under chloroform. One can arouse a patient who is supposed to be dying from chloroform anesthesia, by suddenly dilating the rectum; the peripheral capillaries will also dilate and the cardiac and respiratory action will again resume. It is possible that the same safety arises in dilating the cervix and vagina in labor, as then we may give chloroform with impunity. The heat center lies in the medulla, and one often observes how dilating the rectal sphincter makes the capillaries flush and the skin sweat. Now, the very opposite often happens, for very often when a sphincter is dilated, as in labor, urinating or rectal dilation, the subject has a distinct chill. This is due to the disturbance carried to the heat center in the medulla. The kind of irritation which produces chill and the kind which produces heat are not yet determined, but both arise by means of the sympathetic nerve.

Reflexes from the rectum, e. g., fissure, produce just the same disturbance upon the system as do reflexes from the vagina or uterus. Both arise by means of the sympathetic, and both result, if persistent, in malnutrition. The reflexes seem to alter (stimulate, depress or produce irregularity) the circulation in adjacent or remote organs.

It is well known that young girls who have a uterus badly

developed and anteflexed, suffer from constipation and rectal troubles. It is likely that the constipation and rectal trouble is mainly due to reflex action by means of the abdominal brain. It is known that long continued irritation of a voluntary muscle causes fibrous degeneration and finally cicatricial contraction. Now it is also well known that women possessed of rectal trouble soon acquire uterine trouble. It is due to reflex action, the rectal irritation is sent up the abdominal brain and reorganized and then transmitted to the uterus, inducing circulatory and nutritive disturbance.

The sympathetic nerve, as its name implies, is liable to be brought in unison with surroundings. For example, when the young pregnant wife begins to vomit the young husband soon vomits also, a purely mental impression through the sympathetic nerve. The effect of the sympathetic on the glands of woman is important. The main glands are (a) mammary: (b) the sebaceous on the face and (c) those of the vulva. As soon as menstruation begins (or a little later) the girl begins to have facial acne. The sebaceous glands of the face inflame, enlarge and have a severe exacerbation at each monthly. Some women look almost as if they were chronic drinkers at the time of menstruation. A monthly rhythm excites and exacerbates the facial sebaceous glands into a chronic inflamed condition. (These glands may be trying to imitate the glands in the boy in enlarging a growing beard.) The trouble is due to the sympathetic and is especially active in the face by reason of the presence of the ophthalmic ganglia, Meckel's ganglia, otic ganglia and sub-maxillary ganglia—all sympathetic ganglia situated on the fifth cranial nerve. This facial acne, highest at the maximum of the rhythm of the automatic menstrual ganglia, is very annoying to many women. At the climax of the menstrual rhythm, there may be noticed on some women, dark discolorations, or pigmentation, just below the eyes. This pigmentation of the eye-lids is what is so frequently mentioned as the dark rings about the eyes. It is due to deposit of pigment induced by venous congestion. The congestion is brought about by the rhythmic irritation

of the ophthalmic ganglia (sympathetic) on the supra-orbital branch of the trigeminus. The congestion and pigmentation of the eyelids in menstruation must also be connected with the presence of large glands known as the Meibomian glands. The sympathetic nerve has a predilection and a dominating influence over glands; so that the eyelid congestion and consequent pigment deposit during menstruation must be associated with the ciliary ganglia of the Meibomian glands.

In the pelvic diseases of young girls, I have found quite frequently an association of weak eyes. This is especially the case with endometritis, deficiently developed uterus and dysmenorrhea. They can use their eyes to read but a few minutes at a time, without pain or the letters blurring. I could find no reference to the subject in gynecological text-books. Since writing the above I have learned from Dr. B. Bettman that Dr. Fritsch and others have investigated the connection between pelvic and eye diseases. It must be that there is some prominent connection between certain cases of female generative disease and eye trouble. I have noted so many cases that I cannot consider it an accident and believe there must be some physiological connection. The eyes are worse at the maximum of the menstrual rhythm. The explanation of this association must lie in the sympathetic nerve.

I suggested the subject to Dr. Frances Dickinson, Professor of Ophthalmology in the Chicago Post-Graduate School, who has carefully followed some of the cases. So far, the doctor has reported that the eye trouble seems to be in the general circulation of the eye, the visual apparatus (the cornea, lens and retina) being normal. The endurance of the eye for work is lessened, and it appears to me that the chronic defect in the blood canals is accounted for by the disturbance in the rhythm of the ciliary ganglia, and the sympathetic nerve supply of the Meibomian glands accounts for the pigmentation of the lids. What role the lachrymal glands play in the matter of eye trouble through the sympathetic, I am unprepared to state.

The associated disturbances of the mammary glands in

menstruation and gestation, have attracted the attention of many thinkers. The problem must be solved through the sympathetic nerve. The spinal nerves supplying the mammary glands come from the cervical plexus and the six upper dorsal nerves. The arteries which supply the gland are the long thoracic, internal mammary, the intercostal arteries under the gland, and a few branches from the axillary arteries. Now, on these arteries, the sympathetic nerve goes to the gland. The first stage of milk secretion is a silent process reflected through the cord. The second stage is a gross reflection through the splanchnic from fetal irritation in the uterus; the cerebro-spinal nerves elaborate milk, but the sympathetic hastens its secretion.

The original irritation nearly always arises in the pelvic organs. It travels to the mammary gland in three ways. First, by the way of the spinal cord. Second, by way of the lateral chain of the sympathetic. Third, the main way is up through the hypogastric plexus to the abdominal brain and then through the great sensory nerves of the viscera, viz.: the three splanchnics. But we must again consider that the mammary gland has a peripheral nerve apparatus which not only shares in the genital rhythm, but also has the capacity to form milk. The mammary gland must be looked on as simply a modified sebaceous gland and we have noticed above how the sebaceous glands of the face are affected by menstruation and gestation. The spinal nerves do not induce any rhythm in the glands as is shown in girls up to puberty. But the impetus to rhythm must suddenly arise at the peculiar condition known as puberty, or the period of tubal motion.

The sebaceous glands on the vulva are large and the odor at menstruation is chiefly due to their increased secretion. The vulvar glands are remnants of ancient life when the female, in heat, attracted the male by the increased odor emitted from the active glands. The odor during menstruation is often due to the over-activity of the vulvar sebaceous glands and decomposition of their products, not merely to decomposition of menstrual blood. Here, as in other glan-

dular apparatus, the sympathetic nerves play an important part.

The sympathetic nerve seems to play a significant role on the heat centers of the medulla. I have noticed this especially in laparotomy and vaginal hysterectomy. In short, when certain bundles of sympathetic nerves are cut, especially the hypogastric plexus, the temperature will rapidly rise above or fall below normal.

Surgeons are alarmed at these manifestations until experience teaches their real meaning.

The practical application of the sympathetic nerve in gynecological work lies in its control over nutrition. Reflex irritation from a pelvic viscus will remotely, or through several years, impair the whole visceral economy. Remote effects of pelvic disease must be traced through the nervous system (sympathetic).

The connection of the cerebral cortex (the seat of epilepsy), with ovarian diseases resulting in so-called hystero-epilepsy, is far from being proven.

The different sizes of the peripheral ganglia in the various viscera is an important element in studying the sympathetic. Some viscus may have abnormally small ganglia and hence its rhythm and nutrition will be defective. Small automatic cardiac or menstrual or gastro-intestinal peripheral ganglia will be unable to do normal, vigorous, nutritive and rhythmic work, thus making the visceral system defective.

Menstruation and the menopause I shall place in the realm of the sympathetic nerve. The peculiar cycles and rhythms throughout the life of woman demands attention. We may call attention to the wide domain of the sympathetic nerve not only in health, but also in disease. Having made considerable investigation in this subject, some of the resulting views may be of interest and may stimulate the study of the sympathetic nerve.

THE AUTOMATIC MENSTRUAL GANGLIA.

"We are shaped and fashioned by what we love."—*Goethe.*

MENSTRUATION is a regular periodic monthly rhythm of the uterus and Fallopian tubes. In general it begins at the

age of 15 and ceases at 45, continues four days, the bloody flow amounting to two ounces, and should be painless.

Menstruation belongs distinctly to the tubes and uterus. It is a singular rhythmic action. It is controlled by the automatic menstrual ganglia situated in the walls of the tubes and uterus. These rhythmic little brains manifest themselves to the observer by circulatory change and increased motion. Menstruation might be named tubal motion. By direct observation in the human, and also in animals, I have noted the following condition midway between the monthly periods, or at times far remote from œstrus or rutting: The tubes and uterus are of quite a pale pink color. In short, they are not congested, and are in repose. But at the menstrual period or season of œstrus the tubes and uterus are congested and in active peristaltic motion. The tubes are of a dark blue color from their dilated vessels being filled with blood. The congestion of the uterus is intense but not so manifest as the tubes. The tubes are swollen, thickened and œdematous. They are soft and pliable.

At this time a slight irritation while removing them soon excites them into active peristaltic motion. After removing such tubes and placing them in warm (salt) water they will keep up vermicular movements for half an hour by gentle irritation. I have been able to make these observations in women because I operate at any time in laparotomy, after careful preparation, even if it be in the midst of a menstrual period. As regards animals I have examined several hundred genitals of recently butchered sows, and the tubal congestion at the œstrus is more apparent in them than in the woman. The sow's uterus is also probably more congested. Observations and experiments indicate that menstruation is a regular, periodical rhythm of a blood-wave in the tubes and uterus induced by the automatic menstrual ganglia. The continually moving wave rises to a maximum and sinks to a minimum. The menstrual wave continues from puberty to the menopause. It is a nervous phenomenon.

Ovulation is a progressive, non-periodical process. It begins before birth and continues until the ovarian tissue is

atrophied or worn out. It is liable to occur at menstruation or œstrus because of the vast blood-supply at that time which hastens the follicle to ripen and burst. In the lower animals, so far as I can decide, menstruation and ovulation seem to be coincident, i. e., they occur at the same time. I have examined the cow, dog and sheep, but my observation is especially based on the ovular and menstrual process as seen in the sow. By the examination of some two hundred and fifty specimens of sow's genitals in all conditions it seems to me that the œstrus of the animal embraces both menstruation and ovulation in one physiologic process at the same time. But as the scale of animal life ascends, the processes of menstruation and ovulation seem to become more and more divorced. To my mind the best animal to begin with is the cow. In the cow one can see more and more distinct processes with the ovaries and tubes. Their separate workings become more apparent. In the calf, before and after birth, ovulation is very manifest. But the tubes and uterus before birth and for a considerable time after, are manifestly quiet and pale and rudimentary, nonfunctional. In woman it is my observation that menstruation and ovulation are found distinctly separate from each other. It is true that ovulation and menstruation may occur together, may be coincident, but that is an accident. The processes are physiologically separate. In the woman ovulation has been observed before birth, and I have seen ovulation in a woman of 70, the specimens of which were presented to me by Dr. Burgess of Milwaukee. Now, of these two great physiologic functions, ovulation is a life-long process. It begins before birth and ends with ovarian atrophy. But menstruation is a periodical process beginning with puberty and ending with the menopause. Puberty, must be observed as initiating the new exercise of genital ganglia. A viscus assumes a new rhythm which disturbs the entire system.

The views here contained are that menstruation is governed by nervous ganglia situated in the walls of the Fallopian tubes and uterus. I have designated these nervous structures as automatic menstrual ganglia. As a deduction

of this theory, tubal motion and tubal changes will be considered the most marked phenomena of menstruation.

The question may be asked: What is a nervous ganglion? A nervous ganglion is a collection of nerve cells. Its constituents are nerve cells and nerve fibers. It is an ideal nervous center having a central, conducting, and peripheral apparatus. A ganglion is a little brain, a physiological centre. It has the power of receiving sensation and transmitting motion. It is automatic in itself. It possesses the power of nourishment and controls secretion. Reflex action can be demonstrated in it. What are called motor, sensory, and sympathetic nerve fibers are found in its composition. The peculiar feature of a nervous ganglion is rhythm. It performs cyclical movements. It has a periodic function which continually waxes to a maximum or wanes to a minimum. It lives a rhythmic life. Its periods of action vary from a few seconds to a month. It is beyond the control of the will.

1. The proof of the existence of the ganglia in the tubes and uterus is from analogy. All hollow viscera have ganlia in their walls. Histologists have long known that many viscera possess ganglia which have automatic power. The names of Bidder, Schmidt, Ludwig, Remak, Meissner, and Auerbach are associated with the discovery and description of these visceral ganglia.

(a) I have satisfied myself many a time, in vivisection on dogs and other animals, that the heart has nervous centers or ganglia, which will continue to act independently of their cerebro-spinal connection. It is not only clear that the heart has automatic ganglia, but that nearly all these ganglia are centered in the walls of the auricles. I have often watched the heart's action gradually die out from apex to base. We know by experiment that the heart will perform its cycle of contraction independently of its external connection. These automatic nervous ganglia situated in the wall of the heart keep up its rhythm, its cyclical action, its periodic movements. They explode oftener than once a second. I have severed the heart from its attachments in some animals and watched its beating cease, when, if left alone, it would be still forever; but by applying stimulus to

the ganglia the heart would again perform its rhythm. It would beat and explode just the same as when it was connected to the cerebro-spinal system. Hence few observers doubt that the ganglia of Remak, Bidder, Ludwig and Schmidt sustain and control the rhythm of the heart. One can prove by experiment that there are several ganglia situated in the auricle by cutting pieces out of its wall. If these pieces are stimulated they will go through a distinct rhythm.

(b) A large number of experiments on the intestines of animals (especially the dog) convinced me distinctly that the intestines are endowed with automatic ganglia in a similar manner to the heart. These ganglia are called the plexus of Auerbach and the plexus of Meissner-Billroth. If a dog is killed and the abdomen is opened in a room of 75°, the intestines can be induced to perform peristalsis for an hour after death by tapping them occasionally with a scalpel. As soon as the intestines are exposed to the air or tapped with the scalpel, they begin to go through wonderful vermicular movements resembling a moving bundle of angle-worms. I have often demonstrated the peristaltic movement of the intestines more than an hour after death, so that it can be stated that the automatic ganglia of the bowels will perform their rhythm independently of the cerebro-spinal center. I have found the intestines in autopsies invaginated, and from the non-congested and non-inflammatory condition of the gut wall I had no doubt the invagination occurred entirely after the patient's death. This non-inflammatory telescoping of the intestines in dying subjects is called the "invagination of death." It can be perfectly demonstrated in a dog's intestines fifteen to thirty minutes after he is dead. Hence the nervous bulbs studded over the plexus of Auerbach and the plexus of Meissner-Billroth are the automatic ganglia which induce, sustain, and control the rhythm of the intestines. The vigorous rhythmic exercise or explosion of the intestinal ganglia is what causes colic, and in bowel obstruction occurring in patients having thin belly walls I have observed this with perfection. The intestinal rhythm caused by the ganglia can be beautifully

seen in the defecating gut of a patient on whom colotomy has been performed.

I have never seen the causation of the very severe pain in angina pectoris very satisfactorily explained. I would suggest that it is colic of the heart, caused by abnormally vigorous action of the heart's automatic ganglia; that the desperate pain in angina pectoris is due to the excessive exercise or abnormally vigorous, irregular rhythm of the automatic ganglia situated at the base of the heart. Hence, clinically, no doubt, we see the abnormally vigorous rhythm or irregular rhythm of the heart in what is called neuralgia or spasm of the heart, or angina pectoris. The ganglia offer the best explanation. Clinically, we see in the intestines the exercise of Auerbach's and Meissner's ganglia in various diseases.

In colic and also bowel obstruction we see an excessively vigorous, irregular action of the ganglia. We note an excessively irregular action of the ganglia in the desperate, painful colic of children, which I believe amounts in many cases to an invagination with subsequent spontaneous disinvagination. It may be noted that irregular action of the bowel ganglia occurs in children where the cerebrum is insufficiently developed to force the ganglia of Meissner and Auerbach into subjection and thus secure a regular rhythm of the gut. We also see irregular ganglionic action in the bowel where the cerebrum is diseased and hence has lost a controlling influence. In chronic constipation, and in the paralysis of the gut during peritonitis. we see disease of the ganglia producing such loss of power that the ganglia cannot initiate or sustain sufficient peristalsis to expel the bowel contents.

(c) The same statement can be made relative to the bladder. It is supplied with two kinds of nerves. One kind is the cerebro-spinal. The other kind is the sympathetic nerves, which especially go to the body and summit of the bladder. These nerves are studded over with ganglia which may be styled automatic vesicular ganglia. These ganglia are closely associated with the blood-vessels and walls of the bladder, and have an influence in controlling the rhythm

of this cyst. As an example to demonstrate the action of the automatic ganglia in the bladder, I took from a stag weighing fourteen hundred pounds the bladder, penis, and rectum. In twelve hours after it contracted quite small. I then dilated it, and thirty-six hours after it had again contracted smaller than ever and would not contain half a pint of fluid. This bladder continued its rhythmic action for more than forty hours. It is not mere elasticity, as one can watch the rhythm of segments. It can be well demonstrated by injecting its blood-vessels with red fluid and then watching it for a day, when the slow, cyclical rhythm can be plainly seen. The sacral spinal nerves preponderate at the neck of the bladder and endow it with sensation. They likely hinder it from rhythm, while the body and summit of the bladder are mainly supplied with sympathetic nerves. They give it blunt sensation and rhythm. But the summit and body of the bladder are the parts endowed with ganglia, and they are also the parts endowed with cyclical rhythm.

If a rubber bag is inserted into the bladder and then filled with fluid, having its external end connected with a mercury gauge, it can be plainly seen that the bladder undergoes intermittent contraction. It will demonstrate its rhythm. Clinically, this rhythm can often be observed in retention of urine. The filling bladder will periodically make vigorous efforts to expel its contents, and the pain felt at those times can be easily mistaken for colic. Hence the bladder is endowed with automatic vesical ganglia, which are mainly situated in the walls of the body and summit, especially localized along its highways of nutrition (blood and lymph tracts). These ganglia preside over the rhythm of the bladder.

(d) The analogies of the heart, intestines and bladder are quite apparent, and can reasonably be carried to the uterus and tubes. They are all hollow organs. The tubes and uterus are no exception to the other abdominal viscera. What is said in this paragraph is the result of examination of over seven hundred uteri, tubes and ovaries, of woman, cow, pig, sheep and dog. Some of the examination was carried on during the life of the animal, and in quite a num-

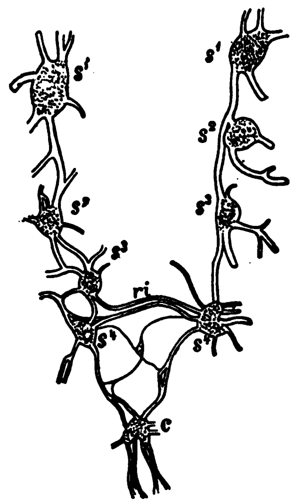

Figure 12.

(Rauber). Represents the sacral portion of the sympathetic of an infant. s1, s2, s3, s4, sacral ganglia; c, coccygeal ganglion; ri, branches which unite the ganglia of the two sides

ber of cases I noticed the action of the tubes in the living woman during operation. Much of the work was done on freshly butchered animals, where the organs were removed before the general muscular twitching had ceased. My first distinct attention was drawn to the idea that the heart, intestines, uterus and tubes acted similarly, by observation in the slaughter house. Dr. C. S. Miller and myself were watching the slaughter and evisceration of a cow weighing fifteen hundred pounds. The cow was in the eighth month of pregnancy. The butcher amputated the large uterus, containing the calf, a little above the internal os. I noticed that the amputated portion of the uterus containing the calf went through a peculiar series of rhythmic motions. But the interesting scene was the amputated stump left on the body of the cow. The stump was about six inches long and three inches thick. This stump performed its peculiar rhythm long after the cow was dead. It slowly described circles and arcs with diameters varying from an inch to four inches. Each muscular layer of that thick uterus worked in perfect harmony. No uterine layer of muscles interfered with any other. Every part of the uterine stump seemed to work with intelligence or a kind of quasi-judgment during the rhythm. At one time the circular muscular layer would go through a slow but distinct rhythmic circle before any other muscular layer would begin. Then, gradually, the longitudinal muscular layer would begin to act, and the end of the stump would describe a rhythmic cycle, and thus it continued to repeat the rhythmic action until we left an hour after. During the activity of the stump the most striking example of the action of the two muscular layers of the uterus could be seen, for while one layer worked vigorously the other remained still. Another striking example to show that the hollow uterus has its own automatic ganglia may be observed by removing the uterus from a cow immediately after death. The uterus should be that of a multiparous cow, because such have long, thick, tortuous, helicoid arteries. Now carefully inject the utero-ovarian arteries with red fluid. Observation will easily detect rhythm in the segments of this uterus for some forty

hours after death, in a 75° room. The rhythmic waves that pass over the uterus will shift the fluid from one segment to another, so that the quantity of fluid is not uniform in each segment. The rhythm sometimes takes place very slowly. This phenomenon is not elasticity. But, clinically, the rhythm of the pregnant uterus has been known since the art of obstetrics began. My purpose here is simply to draw attention to the independent action of the uterus from a cerebro-spinal connection, and to show that the uterus has automatic ganglia like other hollow viscera.

Labor will take place under profound anesthesia. Children have been expelled from the uteri of dead women. All this is due to the nerve apparatus of the uterus. Some Frenchman severed the spinal cord of a pregnant sow below the brain, thus paralyzing all the voluntary muscles which aid in parturition, yet the sow had her pigs. The uterus drove one fetus into the vagina, but as the abdominal muscles were paralyzed this fetus had to be driven out by the second fetus, which was pushed against the first by the contracting uterus.

(e) The Fallopian tube is simply a continuation of the muscular walls of the uterus, but not of the endometrium. The endometrium seems to be a temporary gland, whose duration of active life is the menstrual period. The analogy of the hollow tube of the intestine or heart is very close. Nearly all the original work done on this subject was in relation to the tubes, for I consider them the most important organ in menstruation. The object of menstruation is to get an egg from the ovary to the interior of the uterus. This can be done by a properly prepared Fallopian tube. It seems to me that menstruation begins and ends in the tubes, and that the importance of the tubes overshadows all other organs in menstruation. When the tubes begin their rhythm the girl has arrived at puberty. Tubal motion is a sign of womanhood. When the tubes begin their cycles it is a heraldic sign that the gland called the endometrium is prepared to nourish an ovum. The endometric gland is no doubt often prepared to nourish an ovum before the tubal motion or menstruation, and from the examination of nearly

eight hundred ovaries I am fully satisfied that ovulation goes on from before birth until the end of life, or till the germinal epithelium is worn out. Actual observation of animals convinced me of this. One can see no changes in the ovary at puberty, except that of increased vascular supply. I never could find any periodicity, nor signs of it, in the ovulation in the human, cow or sheep. The ovules simply ripen progressively and burst when they are mature, whether that be at menstruation or at some other time. I am sure they often burst by mere mechanical accident. Hence, it does seem that menstruation and ovulation are two different processes. Two statements may then be made relative to an egg being carried into the uterus: First, when the tube goes through its menstrual rhythm it may secure an egg, if it happens to be ready and bursts. Second, the tube may secure an egg, if its fimbriated funnel becomes glued on to the ovary at a point where there is a maturing ovum.

2. *The Proof of the Existence of the Ganglia in the Tubes from Direct Observation and Experiment.*—If an adult female dog is taken and well anesthetized, and the abdomen opened, the short white Fallopian tubes can be found just posterior to the kidney, at the abdominal end of the double uterus. Two important matters will be observed—first, the condition of the tube; second, the position of the tube. If the animal is not in rut, which is very analogous to menstruation, the tubes will be very white, small and still. They are very much contracted, and the fimbriated end generally lies as far from the ovary as the fimbria ovarica will permit. In short, in the interœstrual time non-congestion and quiescence mark the tubal condition. The condition and position of the tube at the period of rut are wonderfully changed. The tube is very much swollen and elongated; it is dark blue from, especially, venous congestion. The surrounding blood-vessels are enlarged, tortuous and distended. The tube shows convolutions and tortuosities plainer now than at other times. The tube having become longer and thicker, its entire position is changed. The strip of (muscular) tissue which connects the fimbriated end of

the tube to the ovary has shortened, and the funnel mouth of the Fallopian tube is closing on to some portion of the ovary. At the climax of the menstrual rhythm the fimbriated mouth of the tube is often glued or cemented on to the ovary by a kind of glairy mucous exudate. The careful examination of nearly eight hundred tubes satisfactorily demonstrated to me that the tubes go through a distinct rhythm at menstruation. Menstruation is a periodic cycle of the tubes. The tubes go through a peristaltic or vermicular motion exactly analogous to the intestine. Now, there is only one kind of apparatus which produces a rhythm, and that is a ganglion. Hence, as the tubes go through a rhythm, they must be influenced by a ganglion.

The changes in the tubes at puberty are as follows: (a) It assumes rhythmic movements. (b) Its muscular action increases. (c) Its vascularity is much increased. (d) It straightens out and loses its corkscrew or spiral shape of fetal life. (e) Its epithelium become cilitated. (f) Its gross activity appears mainly at the abdominal end. (g) Its lumen becomes filled with fluid. This fluid is to float the egg or ovum along into the uterus. The cilia whip the fluid in the tube into a current, and this wonderful anatomic and physiologic canal floats the ovum to the nourishing gland—the endometrium. The automatic menstrual ganglia during their rhythm produce such changes in the tube as will best prepare it to float an egg from the ovary to the uterus. As the rhythmic peristalsis of the tube reaches its climax the tube becomes thicker, longer and its caliber wider. The fimbria ovarica shorten and draw a tubal funnel over a part of the ovary. A dry, contracted tube with a narrow lumen offers difficulties for the passage of an ovum. If the epithelium of the tube is so altered by disease that it does not secrete fluid, the egg may not be able to float through the tubal canal, but may become arrested in its passage, causing ectopic pregnancy. The reason why an egg does not get into a child's uterus is because its tube is deficient in motion; the fluid in its interior and the ciliated epithelium are deficient. The ciliated epithelium whips an egg into the uterus by means of a fluid medium. The rhythm of the

tubes, caused by the ganglia, prepares them for their function. This is done by first drawing the mouth of the tube over a part of the ovary; and, second, by flooding the lumen of the tube with serous fluid. Of course it will be only accidental that the mouth of the tube will cover a matured ovum. The vast majority ovulate into the peritoneal cavity. Ovulation is a life-long process, while menstruation, or rather tubal rhythm, lasts about thirty years.

The almost entire separation of the tube from the ovary is peculiar to the higher animals, and no doubt lessens the chances of excessive reproduction. In the hen the ovary and oviduct are continuous. The active explosion of the automatic menstrual ganglia are the most marked at the abdominal end of the oviduct. By direct experiment it is easy to make the tubes perform their rhythmic, vermicular movements for half an hour after their removal from the living. The tubes of a cow, sheep, dog or pig can be kept going in a warm medium by stimulating or pinching them, just in the same manner as pinching the heart or tapping the intestines will keep up the movements of those organs in vivisection. I have made this experiment many times on the normal tubes of women where they were removed for various causes. While the operation is going on one can see the tubes going through a rhythm from mere manipulation. As soon as a tube is removed, if it be normal, a rhythmic action may be produced by pinching it. The two muscular layers of the tube will work separately before the eye. The external longitudinal muscular layer shortens the tube, while the internal circular muscular layer narrows the tubal lumen. A tube will keep up this rhythmic motion for about half an hour, if pinched or stimulated in a medium (salt water is a very good medium).

The large range of movement of a human tube under stimulation is very marked, and the vigorous manner in which the two muscular layers of the tube work is very noticeable. If the circular layer is well stimulated, it will contract with such vigor as to resemble a pale, contracted band around the point of irritation. The endometrium may be looked on as a temporary gland, whose duration of life

is the child-bearing period. So the automatic menstrual ganglia which govern the rhythm of the tubes and make fecundation possible are only temporary ganglia, at least so far as function goes. The automatic menstrual ganglia begin their functional life in the incipient tubal motion.

This is not the only organ that acts merely at a definite period of life, though the organs exist anatomically during the whole of life. The thymus gland is largest at birth. The thyroid gland becomes most active in girls about 15. The sebaceous glands of males spring into functional activity at about 18. When the menstrual ganglia of woman begin to cease their functions forever, the sebaceous glands of the face assume an active function, and a beard results. The salivary glands do not act for three months after birth. No doubt the facial sebaceous glands existed always, anatomically but not functionally. It has appeared to me for some time that there exists some relation between the testicles and sebaceous glands in the male, as there does between the automatic menstrual ganglia and sebaceous glands in the female.

Whether the rut (œstrus) of animals and the menstruation of woman are the same or different processes we will not discuss now. But the function of the ganglia and their actual rhythmic process would be precisely the same in either case. In mammals a tubal rhythm with its associated changes is almost a necessity to transport an ovum from ovary to uterus. I could not observe any difference between the state of the tube and the relation of its mouth to the ovary in animals in rut and the menstrual process of woman. The gross anatomy of both processes appeared identical.

Premenstrual Pain.—The pain immediately preceding menstruation is generally not well understood. I have observed that many gynecologists of the present day attribute the premenstrual pain to the uterus. They say the pain is due to the mechanical obstruction to the menstrual fluid. These views may apply to certain cases. But I maintain that the premenstrual pain is due to an excessive action of the tubes or a too vigorous rhythm. The automatic

menstrual ganglia are overexcited and act irregularly. The excessive stimulation arises mainly from the fluid which finds its way into the lumen of the tube. The fluid in the lumen of the tube, arising out of its congested state, acts like a foreign body and excites tubal action. The ganglia become immoderately excited in tubes whose lumen is partially or wholly closed. The vigorous attempts of the tubes to expel the fluid confined in their lumen produce well known agonizing pain. I have examined women with distended tubes who would repeatedly tell me that the pain excited by the examination would last for hours. The tubes were simply excited into peristalsis by irritation of their ganglia.

Dyspareunia, so frequent in tubal disease, is not merely a story of pain at the time of connection, but of pain that endures for hours. Part of the pain is due to trauma of irritable nerves, but the worst pain is caused by setting in motion the vermicular action of the diseased tube. The confined fluid in the tubes excites them into peristalsis, just as irritating substances excite the intestine into painful peristalsis. If an intestine, through obstruction, cannot expel its irritating contents, the picture of pain is almost identical with premenstrual pain. In fact, I have often wondered whether I was dealing with intestinal or tubal colic. It must be remembered that muscle governed by sympathetic ganglia acts quite differently from muscle governed by spinal nerves. One is slow and rhythmic, while the other is rapid and more spasmodic.

The pelvic brain (cervico-uterine ganglion) is a large mass of aggregated sympathetic ganglia situated on each side of the pelvis at the junction of the uterus and cervix. It doubtless shares with the abdominal brain in originating, sustaining and inhibiting the menstrual rhythm. The pelvic brain, like the cervical ganglia, or that of Wrisberg, occupies a subordinate position in regard to the abdominal brain. It is, however, a prevertebral ganglion. It is not easy to dissect and isolate on account of its white color and resemblance to adjacent tissue. It is three-quarters of an inch long and one-half an inch wide in some subjects, and is

more like a meshwork than the abdominal brain. Its irregular meshes are pierced by numerous blood and lymph-vessels and connective tissue bundles. No doubt the irritable uterus, which Gooch described seventy-five years ago, is caused in a great measure by an irritable pelvic brain. A rhythm produced by a ganglion alone is a very delicate mechanism, and it is no wonder that during the many vicissitudes of menstrual life the rhythm becomes disturbed, irregular and refuses to act.

Anatomical.—The distribution of the sympathetic nerve supply and the spinal nerve supply to the uterus and tubes strengthens the theory of automatic menstrual ganglia. Anatomists agree that the uterine sympathetic plexus branches off to supply the uterus and tubes above the point where the sacral spinal nerves join the sympathetic chain. The sympathetic plexus of nerves with its ganglia supplies the upper portion (body and fundus) of the uterus and the whole of the tubes, while the sacral spinal nerves mainly go to the cervix. Now, it is very likely that the (sacral) spinal nerves have little to do with any rhythm or cyclical action. It is quite probable that they hinder rhythm. They would thus influence the cervix to live a steady life. The ganglia on the sympathetic uterine and tubal plexus, on the other hand, are possessed of a peculiar property called rhythm, so their ganglia would endow the uterus and tubes with rhythm. This agrees with the observation that the body and fundus of the uterus and the tubes are the main part of the genital tract involved in menstruation, while the cervix and vagina, mainly supplied with spinal nerves, remain fairly still. The cervix is a mere guard to the uterus, and does not share in menstruation. These ganglia mainly follow the blood vessels, and the tortuous helicoid arteries supplying the uterus and tubes, which. being long, give much space for ganglia to exist. The ganglia no doubt control blood-supply by regulating the caliber of the artery and the stay of the blood in the veins.

3. The microscope, or sometimes a strong lens, will demonstrate the existence of the ganglia on the plexus of nerves going to the uterus and the tubes. The nerves show

unevenness. At places they coalesce into masses, and the microscope demonstrates their ganglionic character. I have frequently been able to trace the nerves showing distinct bulbs on the posterior part of the uterus. Histologists have some time ago shown that little ganglia exist in the walls of the uteri of animals. But space forbids further discussion here. Every visceral organ has its own supply of sympathetic ganglia brought to it on the walls of the blood-vessels. Each visceral organ requiring it has its own established cycle initiated in primordial life. The rhythm becomes strengthened by differentiation into special organs, and by repetition.

It seems to me that knowledge of the various visceral ganglia will render the function of those organs and their diseases more intelligible. To intelligibly minister to an organ diseased one must know its pathology. The treatment of any disease comprehends part if not all of its pathology. To me the action of the heart under varying states and pressure of the blood is more intelligible with some knowledge of the automatic ganglia which control its rhythm and motion. A knowledge of the functions of the cardiac ganglia clears up many an obscure problem and explains the heart's action under varying conditions. The same may be said of the ganglia of Meissner and Auerbach in rendering intelligible intestinal peristalsis. So a study of what may be termed the automatic menstrual ganglia will perhaps throw more light on the action of the tubes and uterus—organs around which woman is built both mentally and physically. We suggest that the rhythmic function of the endometric gland, its nidation and denidation, should not be neglected as a part of menstruation.

The ganglia in the uterus and tubes of woman generally induce a cycle once a month during their functional activity. The ganglia explode monthly. In the lower animals the automatic uterine and tubal ganglia explode in periods which correspond to the cycle of the rut. It is here concluded that whether rut and menstruation be the same or different processes, they are governed in their rhythm by the automatic uterine and tubal ganglia.

Will these automatic ganglia aid in explaining the function of the uterus, tubes or ovary after surgical or other destructive procedures on any one of the three? I think they will. That menstruation is closely connected with the nervous system, and that, too, with the sympathetic, as it has rhythm, is a common observation. Nerve disturbances disturb menstruation and its rhythm. A sprain in the wrist has checked menstruation. I know a patient who, while menstruating, became frightened by a whistle from a train and did not menstruate for a year. Sudden changes in temperature will alter its rhythm. The mere expectation of marriage will occasionally make its rhythm regular. Marriage, by mental and physical stimulation to the genital apparatus, will often induce regular menstruation. When the nervous system is impaired in strength by wasting disease, there may not be enough vital energy to induce and sustain menstrual rhythms. Tubercular girls cease to menstruate. It is a common observation that fleshy persons have weak resisting powers, and fleshy women often menstruate irregularly. In a precocious, abnormally developed girl we may see early menstruation. In pregnancy and nursing, menstruation is arrested because the nervous vitality is expended in nourishment. The miserable and painful failure of an infantile uterus in menstruation is rather from a deficient endometrium. If vital energies are directed into different channels, or vitality gets to a low ebb, the remaining powers may be insufficient to initiate and sustain the regular menstrual rhythm.

From the views entertained in this paper, that menstruation and ovulation are separate processes, and that the automatic ganglia are situated along the oviducts and uterus and probably closely related with the ovary, it would not be expected that removal of the ovaries would always cause menstruation to cease suddenly. The automatic ganglia of the tubes and the uterus are still intact and will execute their rhythm. Many gynecologists testify that this theory agrees with the facts. Ovaries are extirpated and tubal motion continues. However, the destruction of a part of a connected complex organ soon destroys the nice balance,

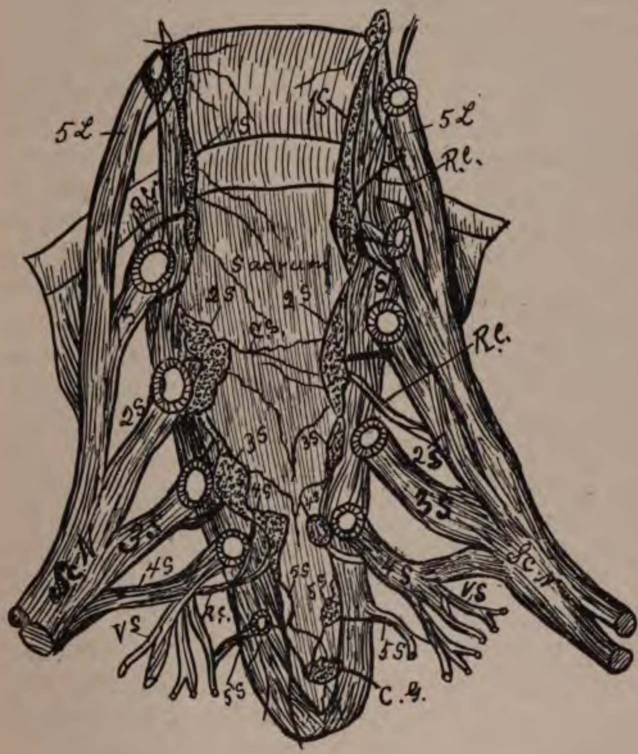

Figure 13.

(Author). Is drawn from a female about 40 years old, and reduced. It represents the lateral chain of the sympathetic, as it is found in the pelvis. 1s, 2s, 3s, 4s, 5s, are the sympathetic chain of ganglia lying along the lateral borders of the sacrum; c. s. shows branches radiating from the ganglia and also joining the chain of ganglia of each side; 5l is the lumbo-sacral cord; 1s, 2s, 3s, and 4s, are the sacral nerves; v. s., is the visceral portion of the 4th sacral; sc. n., sciatic nerve; r. c., rc. and c. are the rami communicantes; c. g. is the coccygeal ganglia. The figure is a typical illustration of the sacral lymphatic chain of ganglia and was drawn after the sympathetic and spinal nerves were carefully dissected and exposed in their natural position. Observe the size and division of the 4th sacral nerve—the important pelvic visceral nerve.

and nourishment of the ganglia would in time deteriorate, and then insufficient nerve vitality with lack of ganglionic harmony would fail in starting and maintaining a menstrual rhythm. Extirpation of the tubes would quite effectually aid in arresting menstruation, though not entirely, as many ganglia would be left in the uterine wall. Yet in the very plan of the machinery the tube is no doubt designed to execute more motion than the uterus, which could perform its function while remaining quite still. By the German gynecologists, during several years' residence abroad, I was informed that a removal of the tubes in a vast majority of cases caused a rapid checking of menstruation. Mr. Lawson Tait writes that the total removal of the tubes arrests menstruation in 90 per cent. of cases. Is it not strange that a tube cut off two inches from the uterus will maintain the rhythm? Actual cases prove that when only the diseased ovaries are removed from women, with inflammation existing in the tubes, they are but little helped in their misery. The active organ in menstruation is the tube, and it will execute its rhythm unless removed. Ligating the tubes is not a rational method, as it will not check the rhythm. Three years ago I began ligating the uterine artery at the neck of the uterus after removing its appendages. This effectually and immediately checked menstruation and rapidly atrophied the organ.

Finally, the tubes and most of the uterus being removed, menstruation will nearly always stop. The ovary, left without a tube, would not sustain menstruation. Cases are reported where the tubes and ovaries and most of the uterus were removed, but menstruation continued. In such cases, no doubt, a sufficient number of automatic ganglia were left to start and sustain a menstrual rhythm. In such cases I suggest that investigation of total removal of the organs and also of the reality of continued menstruation should be carefully done. Patients often call any bleeding menstruation.

I wish to thank Dr. C. S. Miller, of Toledo, Ohio, who worked so long with me on this subject.

Other theories have been advanced as to the cause of

menstruation. Dr. Christopher Martin claims that the nerve centers are located in the lumbar cord. This is doubtless based on the labors of Budge, who located the center of the bladder in the lumbar cord.

THE MENOPAUSE.

"Nature has caprices which art cannot imitate."—*Macauley.*

The menopause ends slowly, as puberty begins. It is frequently difficult to decide which produces the most profound impression on the general system. The popular belief is that the period of menopause is a time of danger to woman. It is claimed that she is more liable to malignant growths of the genital organs or the breasts, and the average woman expects disturbances to arise, either bodily or mentally. Popular belief that woman is more liable to disease at the menopause is probably correct.

The symptoms of the menopause are: (a) cessation of the monthly flow; (b) flashes of heat; (c) flushes of circulation; (d) irregular perspiration. The cessation of the flow is a very irregular and indefinite matter, but generally occurs at about 45 years of age. It requires an average of eighteen months for menstruation to become regularly established; besides, the genitals were being prepared for several years. It requires two and one-half years for the monthly flow to cease, on an average. The flow ceases very irregularly, even in normally physiologic cases. The flow may be scant one month, not appear at all the next, and the third or fourth a flooding may occur. Should the flow cease without pathologic manifestations? I would answer "No." Many no doubt will oppose this view and say that it is a purely physiologic process, but it is frequently accompanied by ailments. So is labor a physiologic process, but it is frequently accompanied by pain and other disturbances. The cessation of menstruation means the death of a great function, the atrophy of a dominating organ which has the greatest nerve supply of all the viscera.

The beginning of puberty shows vast changes in the entire vascular system and also much change in the whole sympathetic, besides the field of nutrition. The most mani-

fest change at puberty is shown by a perturbed nervous system.

The nervous apparatus of the visceral organs may well be compared to the equalizers on the horse-power of a threshing machine. When the ten horses will pull evenly the gearing works uniformly, but the neglect of one team puts the gearing awry, and though the machine may run, its working is not of such fine balance. The destruction of one function in a well-balanced nervous system is sure to destroy the well-established balance in the others. So that in my opinion pathologic disturbances may be looked for at the menopause. In order to make my views clear and reasonable, let us construct a diagram of the sympathetic system. The accompanying cut represents the sympathetic nerves. It is drawn in the form of an elongated ellipse. At the upper end of the ellipse begins the cerebral communicating artery at the so-called ganglion of Ribes. The lower end of the ellipse ends at the coccyx or ganglion impar. RC shows the connection of this ellipse with the cerebro-spinal axis. The interior of this ellipse is of special interest, for here lies the vast and complicated network of this nervous ring. AB indicates the abdominal brain, solar plexus or semilunar ganglia—the center or reorganizing locality of the sympathetic system. From this abdominal brain, renal ganglia and the lateral sympathetic chain, passes off a large plexus of nerves, down the aorta to the uterus, tubes and ovaries. This is known as the hypogastric plexus. The observation which I note in the dissection of quite a number of old women is, that after the menopause the genitals not only atrophy, but the hypogastric plexus also shrinks away.

However, the abdominal brain does not atrophy. It retains its function and structure to the end of life. Dr. Adolph Meyer, formerly of Chicago University, now in Worcester, Mass., writes me the following letter, which explains itself:

The Worcester Lunatic Asylum.
Worcester, Mass., Feb. 20, 1896.

"My Dear Dr. Robinson:—

"Nearly two years ago you asked me to give you some specimens of a sympathetic ganglion, to ascertain that it is

not a degenerate organ, but a living organ with numerous ganglion cells. Those of your opponents who would not believe this may see this specimen from a woman of 74, who had been insane thirty years and died of heart-rupture. The ganglion cells of the semilunar ganglion are large, numerous, moderately pigmented (not more than the spinal ganglia and other nerve cells)."

Adolph Meyer.

The hypogastric plexus becomes smaller, finer and no doubt some strands disappear at the beginning of the menopause. On this fact must be based the pathologic symptoms accompanying the cessation of the menstrual function. In dissecting infants which have lain in alcohol for some six weeks, the very opposite condition of the hypogastric plexus may be observed, for in the young child the hypogastric (sympathetic) plexus is disproportionately large and can be very plainly dissected out. The explanations of the disturbances of the menopause may be shown as follows: For thirty years monthly rhythmic impulses have passed over the hypogastric plexus to the uterus and tubes. A fixed habit has been established and the genital organs lie in the assimilating and motor grasp of the hypogastric plexus. The importance of the genital organs is shown by the vast nerve supply sent to them and also because the hypogastric originates in great central sources. It arises plainly out of the abdominal brain, the renal plexus and sympathetic lateral chain. It is intimately and closely associated with the whole sympathetic ellipse Now when this great nerve tract, known as the hypogastric plexus, will not transmit the higher physiologic orders, it will unbalance all other parts of the ellipse. If the nervous forces cannot go over an old established line they will go over the next line of least resistance. The hypogastric plexus cannot carry the orders as it is atrophied and destroyed for the old work. Monthly rhythm of thirty years established in the abdominal brain is not to die without a struggle. This explanation will enable us to understand the many pathologic manifestations of every viscus at the menopause. The irritation which

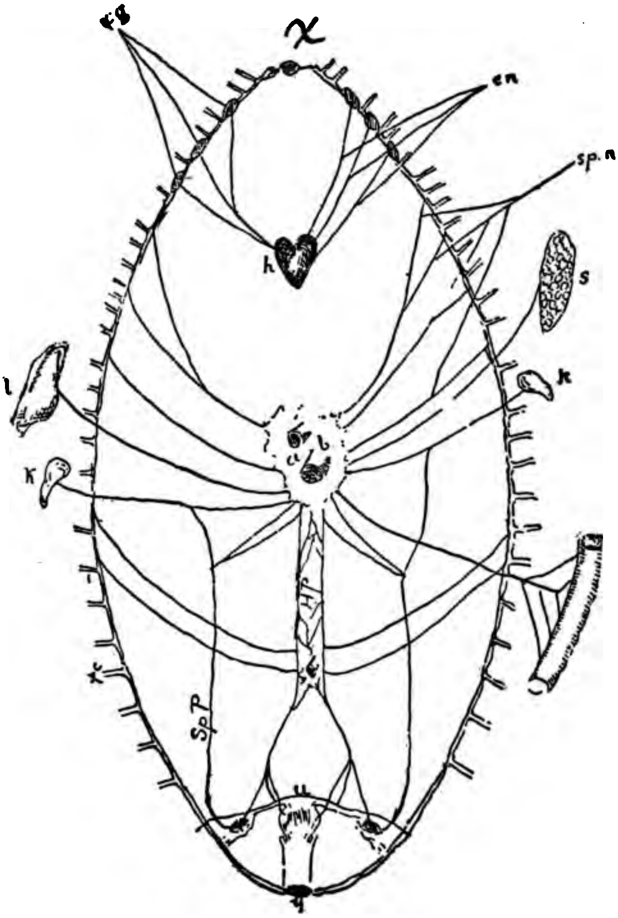

Figure 14.

A Schematic Drawing of the Sympathetic Nerve.
x—Ganglion of Ribs.
y—Coccygeal ganglion (impar).
l—Liver.
k—Kidney.
s—Spleen.
sp. p.—(Spermatic) ovarian plexus.
i—Intestine.
a. b.—Abdominal Brain (center of reorganization).
sp. n.—Splanchnic nerves.
c. n.—Cardiac Nerves.
h. p.—Hypogastric (aortic) plexus (coming from three sources).
u—Uterus, tubes and ovaries.
h—Heart.
c. g.—The three cervical ganglia (secondary center of reorganization.)

The sides of the ellipse represent the lateral chain of the sympathetic. One nerve strand goes from the abdominal brain (a. b.) to each viscus to represent its plexus. Observe that the spermatic plexus (sp. p.) arises from the abdominal brain, renal plexus and aortic plexus. Any irritation starting in any viscus will pass to the abdominal brain, where reorganization occurs, and the forces are redistributed over the plexuses to every viscus.

arose by trying to pass more nervous impulses over plexuses than normal, gives origin to what is unfortunately known as "functional disease." It is just as organic as any disease, only we are not able to detect it. Acute atrophy is a pathologic condition and no doubt this is the condition of the hypogastric plexus at the menopause. The sudden assumption of function of the hypogastric plexus at puberty produces similar disturbances, only they do not assume such definite symptoms as at the menopause. The young woman has more depression than the woman in menopause, unless her ovaries be diseased. The advent of menstruation is an important feature in the life of woman.

After the cessation of the flow the most prominent symptom is what is called flushes. Over eighty per cent of women will experience this peculiar phenomenon at the menopause. Two distinct propositions will explain this subject: Flushes result from a disturbance of the vaso-motor centers, and flashes from irritation of the heat centers. Heat and circulative disturbances are so intimate and go together so frequently that I shall not attempt to describe them separately. The heart and vaso-motor centers are unbalanced by irritation at the menopause. The hot flashes may come on rapidly and irregularly for a short period, and then remain away for days. The patient indicates that the disturbances are first manifest near the stomach, and then rapidly spread over the head and chest. It would seem from carefully watching these manifestations at the menopause that wave after wave succeeds each other. I have watched them under attacks and they seem to be under a desperate struggle to control themselves. The blood-vessels of the head and neck appear most affected, yet the skin of the whole body shares in the disturbance. The nerve impulse, which should be emitted along the hypogastric plexus, is abnormally forced over other plexuses and the vaso-motor becomes irritated, resulting in dilatation and contraction of the peripheral vessels. All molecular action generates heat, and it may be that much of the heat experienced is due to the rapid dilatation of the vast number of vessels and the rapid flow of fresh blood in them. As the cheeks glow the patient experiences

sudden heat, the skin grows, red with flushing blood. Besides the disturbance of the vaso-motor and the heat center the sweat center is also irritated, the flushes and flashes followed by various degrees of sweating. This is just as irregular and uncertain. The quantities of sweat vary from a fine moisture to great drops. It is apparent to any ordinary observer that profound disturbances arise at both puberty and menopause and it is not strange that tradition attributes some diseases to the advent of puberty and many grave conditions to the menopause.

The theory of disease at the menopause must rest on the unbalancing of the nervous system by changing the old established nerve channel through which they have carried impulses for a generation. It must rest on actually diseased genitals, or atrophy of the organs on the plexuses which transmit controlling forces to them. Disease at the menopause must rest on some irritating center, which is chiefly the genitals and their nerves. Like many old gynecologists we need not look for the sole cause in the ovaries, but the trouble is due to reflex irritation. Eighty per cent of such women suffer in general from nervous irritability. Fifty per cent have disturbance in the heat and circulatory centers, Probably 50 per cent suffer deranged sensations, hyperesthesia and anesthesia. Perhaps 40 per cent of women at the menopause suffer from headache, abdominal pain and perspiration. About twenty-five per cent of women at the menopause suffer from leucorrhea, sudden flooding and sweats. This means that all the secretory apparatus of the skin, mucous membrane and centers are deranged. The first thing to suspect in such patients is diseased genitals. Endometritis is an arch fiend at this period in a woman's menstrual life.

Inflammation of some kind may be found in the uterus, tubes and ovaries. Acute atrophy—a form of degeneration or malnutrition—must be recorded among the diseases. If no pelvic trouble be found, the whole abdomen and chest must be examined for some disorder. I have found that the glycerin tampon twice weekly, and the hot douche, gradually increased up to ten quarts twice daily, often cures such

patients, at least symptomatically. Curetting may be required. Radical disturbances in the menopause mean disease, and generally it is located in the pelvis. Women are expected to suffer from neuralgia at this time, nerve irritation, but their intellect is also often disturbed, especially in the will power. General treatment is right and reasonable with baths, and attention to food and evacuations. The patients fret and worry and do not rest or sleep well. The bromides act well, especially given at night. I make over half the dose sodium bromide, as that does not irritate the skin so much as potassium bromide. The bowels are best regulated by a glass of water each night at bed-time, in which there is from one-half to one drachm of epsom salts; with the additional advice to go to stool every morning immediately after breakfast, i. e., after the hot coffee has stimulated peristalsis of the bowel.

It is traditional that women become like men after the menopause and it is common for women to argue against removal of the ovaries, fearing that hair will grow on the face and that they will become mannish. Flesh may increase because of disappearing disturbances. It is common for women to take on fat at the menopause. This is a form of low grade nutrition. I have examined at least half a dozen patients of this nature who were considered subjects of tumors or pregnancy. But a little experience and patience will prove to the physician that the tumor consists simply in abnormally thick and fleshy belly walls.

No one can number the many and varied pains that attack women in the menopause. Most of the pains arise around the stomach, i. e., in the abdominal brain—the solar plexus. The pains which originate in the epigastric region are innumerable, indefinable and baffle all systematic description. We must, however, have the charity sufficient to allow that these numberless disturbances are real to the sufferer. The "something moving in the stomach" may be abnormal peristalsis, induced by a diseased focus, as in the globus hystericus. Whatever opinion is held by the physician a reasonable treatment should be introduced. Such patients have so little confidence in themselves, their physi-

cian and their friends, that they have not the will power to keep up a systematic course of treatment. Hence they go around from one physician to another. The duty of the physician is to locate the disease and attempt to restore order in a disordered sympathetic nervous system, which becomes unbalanced by reason of some irritation arising from atrophy, senility and inflammation. A thorough automatic and physiologic knowledge of the sympathetic nervous system is required for intelligent practice in gynecology. The pathologic condition must be found in order to show skill in removing it. It must be remembered that a stormy puberty generally means a stormy menopause. If a girl begins menstruation with pain and disturbance it generally means diseased genitals—tubes or uterus probably—and the sympathetic system will suffer.

The intimate and wide connection of the nervous system and genitals is phenomenal. The nervous connection of the genitals is profound anl any genital trouble deeply impresses the whole system. It would not be strange, also, if one uterus were found with vastly more nervous connections than another, or at least being much more sensitive than others. My experience in the dead-house, as well as observation in the living, is that viscera vary very much in size. In some a uterus is small, in others large, without regard to the individual stature.

Menstruation must be looked upon as arising and subsiding in the nervous system, especially in the sympathetic system. I would like to make a plea for more study of the nervous system, and particularly the visceral nervous system. From the lack of this knowledge physicians are constantly mistaking nervous diseases for uterine disease. A great evil is going on to-day in regard to the misunderstanding, that a little nervousness does not always belong to the ovaries or uterus. The nervous system is a vast, finely ordered, nicely balanced machine, which can be easily disordered without the least need of removing the ovary, uterus or tube. Some general or local treatment may be amply sufficient. Too many laparotomies are being done to day by unskilled men without proper facilities. Sweeping

removal of organs is a backward step in surgery, and the general disapprobation of the leading gynecologic surgeons must cry it down. It must be insisted that he who would work in the peritoneal cavity must be trained. Training and skill, coupled with a decent sense of right, will alone stand the test of time in any branch of surgery. The colleges must begin with chairs of anatomy and abdominal experiments for small classes. A large plea should be entered for an attempt to understand the pathology of the sympathetic nervous system, i. e., visceral nervous system.

A pathologic state is one manifesting abnormal conditions, whether they are recognizable changes in structure, or simple deranged functions without perceptible disordered structure. There are reflex neuroses, by which I mean disturbances in distant parts produced by irritation of some sensory or motor-peripheral area. It is easy to note that a woman is irritable or nervous, without in the least being able to locate the pathology from which the disturbance originated. One of the most marked features of the menopause is this kind of nervous irritability. It may be easily observed that women in the menopause do not suffer from tumors and malignant diseases so much as they do from disturbance in the sympathetic system and cerebro-spinal axis. Nervous irritability characterizes four women out of five during the menopause. How does this come about? Two ideas explain the complicated but slow course of the disease, viz: Reflex irritation and malnutrition. It can be easily seen that the nervous system is out of balance in the menopause. The beginning and end of menstruation is in the sympathetic nerves. Puberty is heralded by ganglionic rhythm and the menopause comes in at the cessation of the rhythm. The entrance and disappearance of menstruation are nervous phenomena. The genitals then become a point of new irritation as puberty begins, and the genitals are again the focus of irritation as the rhythm departs forever. Menstrual starting chafes the system profoundly, but its cessation irritates the system notably with its dying struggles. By the figure it is plain that any genital irritation can be easily carried to the abdominal brain where the reorganiza-

tion occurs. The newly organized force will go to every viscus in the sympathetic ellipse and damage the rhythm. Now the visceral rhythm is for the purpose of nutrition, and pursues its even tenor in a kind of orderly manner. But irritation from a focus never comes or goes by rule. It goes at all times and any time, while the viscera are performing their nutritive rhythm. The irritation from the diseased focus forces itself up the hypogastric plexus to the organizing center and is emitted to all viscera, in addition to the abdominal nutrition and rhythm and disorders natural to visceral rhythm. Few but the special clinical gynecologist fully recognize that uterine disease is often such a slow process and that it can start a train of evils.

A few weeks or months of pelvic irritation gradually produce deranged visceral rhythm and consequent indigestion. The addition of indigestion to a diseased visceral focus makes a double burden on the whole system. The nerves become more irritable. Indigestion persists and soon brings on distinct malnutrition—another burden to the ganglionic system of nerves. All this continues until anemia arises, the result of waste-laden blood. Now it is apparent to all, when waste-laden blood bathes all the thousands of ganglia and nerve strands in the body, that the patient becomes nervous or irritable. The sympathetic ellipse is unbalanced and its centers are disordered. It is a slow process for a woman to pass from a single focus of visceral disease to a neurotic condition. The whole disturbance becomes intelligible by comprehension of the nervous system and a knowledge of the condition of the diseased genitals. The intelligent practitioner always examines the genitals in a disordered menopause. A stormy menopause means diseased genitals. It means a focus of pathology which is nearly always situated in the pelvis. The effects on the individual may be described by noting how the irritation can pass up the hypogastric plexus to the abdominal brain and being reorganized be emitted to the digestive tract. The irritation goes on day and night; when it reaches the digestive canal by way of the gastric superior and inferior mesenteric plexus it first affects Auerbach's ganglionic plexus of nerves which lie be-

tween the muscular layers of the gut wall. This simply disturbs peristalsis and induces perhaps some colic. But as the irritation passes to Meissner's plexus it disorders secretion.

Thus the great assimilating laboratory of life is deranged. Digestive disorders are common in the menopause. Liver disturbances are not common. The irritation passes through the abdominal brain to the liver, inducing excessive, deficient or disproportionate bile, glycogen and urea. The rhythm of the liver is deranged. Its rhythmical activity and quiet repose are continually disturbed by reflex irritation. It is easy to observe disease of the liver from the condition of the patient in menopause—skin and bowel abnormalities. The route from the genitals to the heart is made plain by the diagram. The irritation from the diseased genitals passes to the abdominal brain, thence up the splanchnics to the three cervical ganglia, whence the reorganized irritation passes to the heart over the three cardiac nerves. The result is that the heart goes rapidly, irregularly—it palpitates.

After nervous irritability the woman in menopause probably suffers most frequently from flushes and flashes, i. e., irritation of the vaso-motor and heat centers. Her skin glows with fresh red blood or burns with prickling heat. This seems to me to be merely an unbalanced condition of the nervous system due to a disordered focus. The transmission goes in a tumultuous manner, over roads which are not accustomed to so much vigorous commerce and the centers are not able to orderly reorganize it. The circulation floods or depletes the vaso-motor centers.

One may observe that some women enter puberty with many indescribable pains and they continue to complain of peculiar abdominal pains during the reproductive period, and at menopause they simply become chronic grumblers and complain more and more bitterly. What must be said of such women? We must not consider them as fabricating untruths for a whole generation; we must attempt to study the ganglionic system of the sympathetic in order to unravel the apparent mystery. We may say that women with these

abdominal pains are in a poor state of nourishment. Debility characterizes the ganglionic disease while irritability is the feature of cerebro-spinal axis pathology. Women with ganglionic diseases are weak, ill-nourished creatures, often unable to do a little housework. Can we not consider that such patients have hyperesthesia or anesthesia of the visceral ganglia. These ganglia are little brains, for they all have the elements of the cranial cerebrum,—nerve cells and processes. In short every nerve cell is a unit in itself. It is an isolated anatomic unit, a neuron, a brain and a reorganizing center. The essential of the cell is the nucleus because it has the power of nutrition, hence reproduction. Hence each ganglion is a little brain, a reorganizing center.

Now, a brain or ganglion cell receives sensation, sends out motion and controls nutrition. It reproduces itself, it controls secretion and lives in balanced relations with its environment. Can we not think that such patients have oversensitive or irritable abdominal brains? Their visceral nerve apparatus is abnormal, it is out of order. But this center holds in abeyance nerve energy and nerve force. It holds all the assimilating and circulatory laboratory in living tension. Such patients have not a perfect machine to work with. Such are generally congenital, or are made so by the acquisition of some profound function, such as menstruation. The female visceral nerves seem to be peculiarly liable to rapid derangement. Women faint easily and slight occurrences disorder their viscera. The flying of a bird will make the heart palpitate. A sudden noise deranges respiration or circulation. A change of locality either puts in order or puts out of order the nervous system. The female nervous system is much more unstable than the male. And no doubt that is the reason that so many physicians mistake nervous disease for uterine disease. Such physicians are either ignorant of the delicate nerve mechanism or are over-zealous operators.

The pathologic condition of the genital organs in the natural menopause is generally atrophy, absorption of fat and consequent shrinkage, lessened vascular supply and consequent smaller organs. It is a pure senile atrophy. The organs

assumed action, served their purpose and subsided forever. Even in a natural menopause the distinct dying struggle may be expected in the hypogastric plexus. Puberty increases the volume of the organs, while menopause lessens it. Puberty is the real birth while menopause is the real death of the female genitals. The appearance of the individual organs at the menopause are peculiar. The vulva wrinkles and shrivels through the absorption of fat and other tissues. In dissecting senile genitals the pudendal sac of Bichat and Savage becomes more apparent than ever. One can push the index finger into it and the greater labia will appear and feel very thin, while the sac seems disproportionately large. The fat rounded form of youth obscures this peculiar pudendal sac even in dissecting. In old women the sac flattens out and exposes the clitoris and small labia. The clitoris becomes smaller and blends with the surrounding parts so much that it is occasionally difficult to find. The vagina becomes smoother in its folds. It contracts in every direction and frequently it may seem to thicken, but that is probably a delusion from blending with other tissue. The cervix gets smaller and may appear entirely absent, from the excessive shrinkage and contracting of the vagina. The uterus becomes smaller and harder. It has a peculiar tough, elastic feeling from the atrophy of muscular tissue. It assumes to some extent the form it had before puberty, except that the neck is more prominent before puberty. It straightens out. Its nerves and vessels shrink. The tubes are notably thinner and shorter. The circular muscular layers seem to suffer most.

The ovaries shrink very much and resemble a peach-stone on the surface. In quite a number of old female cadavers I found them the size of beans and in some it required considerable searching to find and recognize them. Then we found in the contracted and shrunken broad ligament the sheaths and nerves themselves atrophied.

In women with a stormy menopause it is not unusual to find subinvolution. While a pupil of Lawson Tait, several years ago, I gained some knowledge in regard to a disease of the vulva which may not infrequently be seen in women

from 40 to 50, or about the menopause. It is a trouble that one would easily pronounce on a glance, eczema of the vulva. Mr. Tait remarked that it was due to a kind of climacteric diabetes; that is a kind of eczema at the menopause. Dr. Martin, Mr. Tait's assistant, was very kind in displaying to me these unfortunate cases. The labia were swollen and œdematous and the red flaming eczema extended far and wide beyond the vulva. The disease made the patient's life almost intolerable. Mr. Tait's treatment for such cases was a solution of hypophosphite of soda (an ounce to a pint of water). The solution should be applied every two to five hours as required, to destroy the germ which induced the itching. He then gave heavy doses of opium. Mr. Tait claims that there is a kind of diabetes mellitus during the menopause; a limited diabetes, as they all finally recover. The distress of the patient with this climacteric diabetes is due to the sugary urine of the vulva. Peculiar crusts form, due to the multiplication of the vegetable germ known as torula cerevisiæ. The eczema due to this cause will spread over the buttocks, up over the abdomen and even down to the thighs. In one case I saw the eczema extend so far that the patient could walk only with difficulty. The hyposulphite of sodium arrests the formation of this germ. Mr. Tait would sometimes give as high as one grain of opium three times daily and then two grains at night. After a few months of such treatment the opium was lessened, and in from five to ten months such patients fairly recovered. They are liable to short relapses.

M. Lecorche, of Paris, has also made researches independently of Mr. Tait and curiously enough they agree in many ways. Mr. Tait carries his views into more definite plans of treatment. This climacteric form of diabetes is then a disease which begins at the menstrual cessation and lasts a few years. Menstruation seems to give immunity from it. Nature appears to finally overcome it. If the hyposulphite of sodium is inefficient to arrest the trouble, on account of the fluid quickly running off the parts, an ointment of sulphur will remain on the vulva for hours. Any substance which will arrest the fermentation changes in sugar is an effective rem-

edy. I have noted no special form of climacteric vaginitis, but one form is liable to arise which is due to laying bare some peripheral nerves in the vaginal wall. The spots are red and most exquisitely tender; they occur mainly at the vulvar orifice and are very persistent. The treatment consists in applying cocaine and sufficient caustic or Paquelin to entirely destroy the exposed nerves. These neuromatic patches are apt to arise in women at other times also. In severe cases it is best to anesthetize the patient and destroy the exposed nerves widely with the Paquelin.

The special diseases of the uterus which I have observed in menopause are endometritis and subinvolution accompanied with leucorrhea. Chronic endometritis with an excoriating discharge is frequently found. The uterus is generally slightly large. The mouth is red, runs easily and out of it runs a muco-purulent substance of varied color. The hot douche (15 quarts) twice daily and the additional use of glycerin tampons cure most cases. Occasionally a curetting is required, followed by the thorough application of 95 per cent of carbolic acid. I apply the 95 per cent carbolic acid to the endometrium three times, so that it will destroy the old inflamed endometrium, and drain with a little rubber tube or pack in gauze, and remove it in twenty-four to thirty-six hours. Fortunately the senile endometritis is generally cured with one curetting, unlike the stubborn endometritis of youth. Mild forms of endometritis in the menopause I have frequently noted. The subinvolution or suspended involution is a much graver matter. It has had a more evil and wide effect on health and especially on the nervous system. It consists essentially of a metritis, and so far as I can observe rests on an old endometritis. It is not clear whether Klob or Rokitansky is correct, in regard to the theories of the conditions producing a hypertrophic uterus.

Whether the hypertrophic uterus is due to excess of connective tissue or muscle, or whether it is due to a natural proportionate increase of both is still undecided. In such cases a lax pelvic floor is often observed. So far as my experience goes, the tampon and douche are insufficient and

are too slow for satisfactory results. Thorough curetting is the best means at command, with the application of 95 per cent of carbolic acid to the whole endometrium. The cure is slow at best but finally quite satisfactory. The pathology of the climateric or senile endometritis must not be lost sight of. At first the leucorrhea is more abundant. It may be mucous, muco-purulent and finally purulent. The explanation of the changes of the fluid secreted from the endometrium rests on the endometric glands. At first the glands are able to be increased in their function; with time they atrophy, but the inflammation proceeds and finally only sero-purulent substance or chiefly pus results from the glandular destruction; only now and then a glandular endometritis. The remnants only of the endometrium remain and these are involved in a state of low vitality. Low and mild forms of granulation are visible at the neck and can be scraped out of the uterus. Slow necrosis, local death, gradually proceeds until raw ulcerative surfaces are exposed and only pus will be secreted. The glands have disappeared.

We must observe that cervical laceration frequently exists with this trouble. The reason such conditions do not heal well is because the blood supply and nerve supply to the uterus is now being cut off, are imperfect, so that nutrition is very deficient in the uterus. For thirty years the uterus has had high feeding from fresh blood and the fine control of a complicated nerve apparatus, but suddenly the high feeding is curtailed and the delicately balanced nerve apparatus is impaired by the atrophy of the menopause. Hence low granulations, imperfect reproduction of cells, ulcerative surfaces, may be expected. It must be remembered that there are other troubles than cancer in the uterus at the menopause. The essential feature of the climacteric uterine trouble is imperfect nutrition. This will not astonish one so much after he has carefully examined and dissected or post-mortemed a dozen female cadavers above 50 years of age. In them he will note atrophy, shrinkage, contraction and pale white tissue.

The differential diagnosis between cancer and benign uterine disease (endometritis) may be looked for in the case

of cancer by infiltration, thickening and peculiar watery, sanious discharges. As regards ovarian tumors at the menopause they grow more rapidly. The vital power of the patient is at a lower ebb, and besides the nutrition of the ovary is degraded by diminished blood supply and atrophy of its nerve supply.

It would appear that the branches of the hypogastric plexus which are sent to the bladder and rectum are not atrophied to the same degree as the branches sent to the genitals (uterus, tubes and ovaries). Yet in my post-mortems and dissections it appears to me that the vesical and rectal branches do atrophy. The present idea of medicine is that there is an automatic structure disordered somewhere to account for disease. A portion only of a man is diseased and pathologic anatomy would always indicate the origin, had we sufficient acumen.

Now in the menopause the cerebro-spinal axis is disturbed through the means of the vaso-motor nerves, and the circulation by some form of reflex neurosis. A woman's mind is often disturbed. She has lost her old will-power, her memory is impaired. She cannot concentrate effort. She is liable to do damage from inability to control her own action. The law recognizes any deviation from rectitude during the menopause with leniency. The treatment of women during the menopause must be local, general and moral. The cog in the wheel which disturbs even physical existence must be remedied. General debility and irritability must be allayed by anodynes with both tonics and good nourishment, while the unhinged moral views must be removed by changing the life from the old ruts which caused them. One feature must not be lost sight of: When pelvic disease has started a train of evils and continued for years, we cannot expect very much from mere treatment, but radical removal of diseased organs often alone gives relief.

CONCLUSIONS.

1. The average menopause lasts two and one-half years.
2. It comes on slowly as does puberty.
3. A stormy puberty means a stormy menopause generally.

4. The general rule is that an early puberty means a late menopause. In my opinion it simply means that early puberty and late menopause rest on a largely developed abdominal brain and hypogastric plexus. Precocious puberty means well developed genitals and ganglionic nerves.

5. The disturbance at the beginning of puberty is profound, but since it is an active (depletive) physiologic process it quickly fits the growing and adaptive nervous system. But the menopause is a destructive process. It breaks up the harmony of the previous processes and unbalances the even distribution of nervous energy and circulation.

6. It is probable that every viscus receives an equal or greater shock at menopause than at puberty.

7. The changes at menopause consist in menstrual cessation, atrophy of the genitals and the hypogastric plexus.

8. Women do not suffer at the menopause so much from malignant diseases as they do from nervous troubles, neuralgias, mental deviations, disturbed visceral rhythm, disordered circulation, indigestion and above all neuroses.

9. The heat center (flashes), the vaso-motor center (flushes) and the sweat center (perspiration), are the especial centers disturbed. Excessive, deficient or disproportionate blood-supply characterizes the disturbed phenomena of these centers.

10. The etiology and pathology of the menopause lies in the sympathetic or ganglionic nervous system.

11. The sympathetic pathologic stages in menopause are: (a) a focus of disease, or irritation (the genitals); (b) indigestion; (c) malnutrition; (d) anemia; (e) neurosis. It is a slowly progressive process.

12. Atrophy is a disease just as much as hypertrophy or inflammation.

13. Chief among the actual disease in the menopause is endometritis. The peculiar floodings doubtless depend on this inflammation.

14. The menopause is characterized by various discharges (mucous membrane), leucorrhea, bronchitis, hemorrhages from the bowels, epistaxis (skin), perspiration.

15. Circulatory, perspiratory and coloric changes are the common heritages of the menopause.

16. A characteristic phenomenon of the menopause is an unbalanced, unstable nervous system, cerebro-spinal (irritation); or sympathetic (debility).

17. Debility characterizes the trouble in the ganglionic system, while irritability characterizes the cerebro-spinal axis.

18. The explanation of the various phenomena lies in the nervous and circulatory systems.

19. Excessive sexual desire at the menopause is indicative of disease.

20. In the menopause the nutrition is impaired, as is shown by the occurrence of malignant disease in the sexual organs which are in a state of retrogression.

21. A chief characteristic of uterine disease is malnutrition from atrophy, which suddenly limits blood supply. This arises from the sudden degeneration of the genital nerve apparatus and consequent impaired control of tissue by defective nourishment. Ulcerative processes, local death and purulent secretions, arise from low granular cell-formations.

22. In the menopause a disturbed point has arisen in the harmony of visceral rhythm. This pathologic focus must be looked on as the cause of the innumerable reflex neuroses at this time of life.

23. A reflex neurosis is a disturbance in distant organs caused by the irritation of a peripheral sensory or motor area.

CHAPTER X.

GENERAL VISCERAL NEUROSES.

"The telegraph is the nervous system of the world."—*N. Y. Herald.*

The subject of visceral neuroses must be considered under three heads, viz.:

1. Sensory Neuroses.—The state of the sensory nerves must be considered. There will be two morbid states of the sensory nerves to consider; (a) pathological lesions of a more or less demonstrable sort, either in actual changes in structure or evident in reflex action; (b) a neuralgic condition, a state in which no pathologic lesion is demonstrable, a kind of morbid or exalted sensibility or over susceptibility of the sensory sympathetic nerves. The neuralgias and exalted sensibility will be discussed under the hyperesthesias of the abdominal brain and its radiating plexuses of nerves.

2. Motor neuroses, the second subject, including visceral neurosis, will be that of visceral motion, such as visceral rhythm, motus peristaltus.

3. Secretion neuroses, the third subject included in visceral neuroses, will include the phenomena of secretion, such as excessive, deficient or disproportionate secretion.

VISCERAL NEUROSES.

Under this head we will include a series of phenomena of the viscera, partly pathologic and partly reflex, partaking of a disturbance of sensation, motion or secretion. By visceral neurosis we mean an undue irritability or perverted function of one or more of the viscera. The pathologic condition may be demonstrable or not.

In the phenomena of visceral neurosis must be included the clinical fact that if one organ is disturbed it will tend

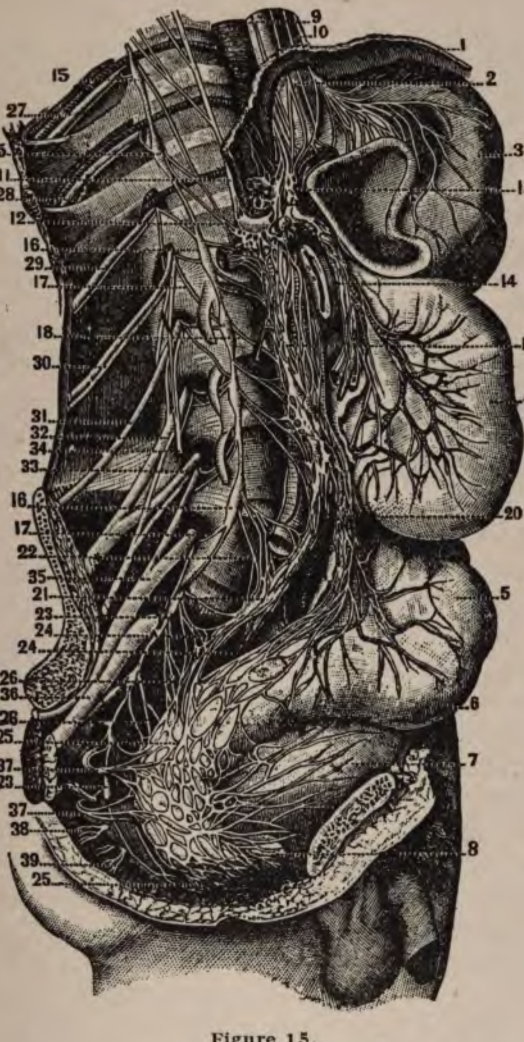

Figure 15.

Lumbar and Sacral Portions of the Sympathetic (*Sappey*)

1, cut edge of diaphragm; 2, lower end of œsophagus; 3, left half of stomach; 4, small intestine; 5, sigmoid flexure of the colon; 6, rectum; 7, bladder; 8, prostate; 9, lower end of left vagus; 10, lower end of right vagus; 11, solar plexus; 12, lower end of great splanchnic nerve; 13, lower end of lesser splanchnic nerve; 14, 14, two last thoracic ganglia; 15, 15, the four lumbar ganglia; 16, 16, 17, 17, branches from the lumbar ganglia; 18, superior mesenteric plexus; 19, 21, 22, 23, aortic lumbar plexus; 20, inferior mesenteric plexus; 24, 24, sacral portion of the sympathetic; 25, 25, 26, 26, 27, 27, hypogastric plexus; 28, 29, 30, tenth, eleventh and twelfth dorsal nerves; 31, 32, 33, 34, 35, 36, 37, 38, 39, lumbar and sacral nerves.

to unbalance the remainder, i. e., irritation is reflected by a nerve arc from one viscus to another. A diseased uterus is frequently followed by a disturbed stomach. A checking of normal function not only makes neurosis but indigestion, non-assimilation and anemia. Such a case occurred in the person of a young woman on whom I performed laparotomy. A few months after the operation she began to suffer tenseness, spasmodic dragging pain in the sacrum at defecation, and colica membranacea arose. She became slowly ill, neurotic and unable to work. Dr. Lucy Waite and I operated on her and all that we found was an organized peritoneal band several inches long stretching from the amputated tubal stump to the middle of the sigmoid. The peritoneal band checked the normal peristaltic action of the sigmoid, producing pain, non-assimilation, anemia and indigestion. She became well after the operation, gaining some twenty pounds. In over a dozen cases during the past three years Dr. Lucy Waite and I have reoperated for old post-operative peritoneal adhesions. We generally found that some loop of bowel was attached to the amputated end of the bowel and checked more or less the bowel peristalsis. Hence, partial checking or hindering of bowel peristalsis produces a peculiar kind of neurosis. All one may notice at first in such cases is irritability. Pain may not be spoken of as the chief annoyance. These subjects with peritoneal bands, which more or less interfere with visceral rhythm and peristalsis, suffer in distant organs from reflex irritation radiating to them. It should be remembered that reflex action goes on in health and disease. Nerves like railway cars carry any kind of freight.

The essentials of a nervous system consist of (a) a central nerve cell; (b) a conducting cord, and (c) a peripheral apparatus. However vast the nervous system, the elements are the same. For example, the skin is the peripheral apparatus, the spinal nerves are conducting cords and the spinal cord the central nerve cells. The same form of illustration may be made in regard to the abdominal brain as in the central nerve cell. The superior and inferior mesenteric plexuses of nerves are the conducting cords (for the bowels)

and the peripheral apparatus is in the mucosa. In visceral neurosis pain is not always the chief symptom. Sub-conscious irritation plays the chief role; irritation which does not come within the field of recognized pain.

In visceral neurosis we should include enteroptosis. The *maladie de Glenard* is doubtless a neurotic disease. Recently Dr. Schwerdt has written some interesting and well studied articles on enteroptosis. Visceral neurosis means that the nervous system in the abdomen and the organs are not living in harmony. The gamut of the sympathetic nerve has lost its tone.

Enteroptosis begins from a weakness of the abdominal sympathetic. It became tired out and slackened its tone. The sympathetic nerves to the viscera have lost their normal power over circulation, assimilation, secretion and rhythm; but the sympathetic nerves have lost their influence over the viscera very slowly, for the enteroptosis is a very slow disease at first and has a long chronic course from the beginning. It may require years to develop. In a later stage of enteroptosis the disturbance of feeling and motion arises, and the nervous symptoms of disturbed digestion, aortic palpitation and dragging sensation. Later the disturbance of motion occurs. The abdominal walls slacken, lose their tone and atrophy (trophic), even the extremities losing some of their delicate balance. But with the lowering of the intra-abdominal pressure the real ptosis of the viscera begins and the neurosis rapidly increases. The anatomical visceral pedicles elongate, the organs begin to leave their bed.

The digestive tract being disturbed, the nervous system suffers from auto-intoxication. Assimilation becoming deranged by a continuously disturbed digestive tract a vicious circle begins its progress. The motor, sensory and secretory nerve apparatus, each and all, become involved.

Anatomically, we observe the order of visceral ptosis (I base this on some five hundred personal autopsies) to be the following: 1, the right kidney; 2, the stomach; 3, the small intestines; 4, the transverse colon; 5, the spleen; 6, the liver, and 7, the genitals. Visceral ptosis belongs in the vast majority of living diagnoses to women, but autopsies

show the disease quite common in women and not rare in men.

The slackening and atrophy of the female abdominal wall makes the diagnosis easy, while the retention of tone in the abdominal wall of men not only makes visceral ptosis rare in men but more difficult to diagnose. The typical enteroptosis occurs in old age when the sympathetic has lost its tone and vigor. In a normal condition of the abdominal viscera the several organs hold a harmonious relation to each other, no nerve plexus is stretched or slackened, and function, secretion, assimilation, circulation and rhythm move on without friction. Now, with dislocated organs dragging irregularly on the nerve plexuses, deranging secretion and assimilation, the suffering becomes manifest in what we know as visceral neurosis. Some designate it hysteria. The lost tone and vigor of the anterior abdominal wall is unfortunate because its vigorous aid to peristalsis is wanting. The loss of the muscular action of the anterior abdominal wall allows congestion of blood and secretions to arise; and constipation intervenes.

In visceral ptosis the skin presents anesthesia and hyperesthesia, also vicarious actions to elemental products. In enteroptosis we have various functional paralysis. The physical and mental vigor is paretic in enteroptosis. It produces languor. The intestinal tract is sluggish, paretic. The bowel suffers in two ways; first, from auto-intoxication; second, from the irritation of the decomposing material on its mucosa, which reacts on the nervous system. The disturbed skin trouble in enteroptosis points to hydrotherapy as the best way out. Baths open the drains of the skin. Enteroptosis is a functional disease.

In enteroptosis as a visceral neurosis we deal with several stages, each of which presents distinct landmarks.

In the first stage we deal with increasing muscular weakness. The patient complains of manifold sensations on account of disturbances in the sympathetic, anemia, defective assimilation and loss of weight. Physical and mental energy become lowered and intra-abdominal pressure becomes lessened. The disease may not extend further.

In the second stage of enteroptosis the name of the disease is quite apt, for the individual viscera begin to leave their old, natural beds. They become dislocated, and permanently fixed in wrong positions. (However, by force or the patient assuming an unnatural position the dislocated viscera may resume their proper position.) With the dislocated organs begin the visceral neurosis, the indigestion and the auto-intoxication. In this stage the abdominal brain and its radiating plexuses, as well as the vessels surrounded, must become adjusted to the new environments of dragging and pressure; compensations of atrophy and hypertrophy will arise. For example, the power of the muscular wall of the abdomen being lessened, the digestive tract must compensate by increasing its muscular wall in order to drive onward the fecal mass.

The third stage, and final stage of enteroptosis, may be observed in some old people. It is the stage in which compensatory hypertrophy fails; and the viscera becoming overfilled, depletion is very imperfect. The digestive tract is unable to empty itself from the remnants of its feasts and excessive congestions arise, the bladder fails to expel but a little urine at a time and the digestive tract suffers from the absorption of toxines and the irritation from decomposing material.

In one case of enteroptosis, postmortemed by Dr. Lucy Waite, and myself, the greater curve of the stomach rested on the pelvic floor. The subject was an old man. In another case in which I performed the autopsy the spleen was resting on the pelvic floor. It is common in autopsies to find the right kidney movable for two inches upward and two inches downward—a range of four inches. The transverse colon is frequently found in the pelvic cavity.

The treatment of enteroptosis may be summed up in the words, hydrotherapy and abdominal supports. The young surgeon who performs nephrorrhaphy for movable kidney will have his hands full, if he has a large practice, for I know from personal experience in autopsy and practice in gynecology and abdominal surgery, that movable kidney is a very frequent occurrence. I should judge that five women

out of ten, who come to my office, have a movable right kidney. Movable kidney is a part of enteroptosis. Now, since patients afflicted with enteroptosis suffer from auto-intoxication, non-elimination, non-drainage and congestion, we must aid nature by establishing general drainage. Frequent salt baths, persistent massage and abdominal supporters are required in the treatment. Above all, the digestive tract must be frequently emptied, by administering a full glass of water with half a drachm of salts and ten drops of tr. nux vomica every night on retiring, and insist on the patient emptying the bowels regularly every morning at the same hour. The abdominal bandage should be of elastic flannel and fit snugly. It may be removed at night. The abdominal binder affords much comfort. In fact, one of the methods of diagnosing enteroptosis is to elevate the viscera and then to note whether the pain ceases.

It may not be forgotten that enteroptosis offers opportunities not only for visceral neurosis, but also for obstinate constipation, which favors the development of visceral neurosis by over-retention of feces, including decomposition of matter, calling up irritation and auto-intoxication. Each factor in enteroptosis induces a vicious circle. The factors in enteroptosis which solicit constipation are:

1. Kinking of the colon by the ligamentum hepato-colicum.

2. Kinking of the colon by the ligamentum phrenico-colicum sinistrum.

3. Kinking of the ascending colon by the ligamentum phrenico-colicum dextrum. I have seen the ascending colon in the pelvis hanging by this band.

4. Kinking of the pylorus by the ligamentum hepato-duodenum.

5. Atony of the gastro-intestinal muscularis.

6. A lowering of the intra-abdominal pressure by atony of the anterior abdominal muscles.

7. The excessively mobile viscera with elongated pedicles locally compromise the bowel lumen.

In visceral neurosis (or neuralgia) we are doubtless dealing with a peculiar form of malnutrition of the nerves of

sensation. Hence in these days of scalpel or no scalpel, of sweeping removal or surgical repair, it behooves us to diagnose with caution the symptoms of disease. In disease we are seldom dealing not only with signs which are distinct clues to disease, but chiefly with symptoms which are only indications of pathology. In visceral (abdominal) neurosis we are dealing with organs which possess (a) motion, (b) sensation and (c) secretion; i. e., such organs have muscles which are set in motion by motor nerves, sensation made manifest by some irritation on the sensory nerve ends, and secretion which proceeds normally in certain quantities, but in disturbed conditions, (a) excessive, (b) deficient, or (c) disproportionate.

In visceral (abdominal) neurosis we are chiefly dealing with the sympathetic—a nerve of rhythmical motion and dull sensation. The term visceral (abdominal) neurosis is a mere name of a symptom in the mind of many physicians, as we say the kettle boils when we really mean that the water boils or is raised to such a degree of temperature that the ebullition occurs in the water.

Visceral neurosis indicates that some deep condition, assimilation or vicious process is proceeding somewhere. The observing physician of experience commonly associates in his mind visceral neurosis with (a) some debilitating process in age or sex. We cast about for predisposing causes and examine them as a neurotic temperament, hereditary or acquired. One can acquire a neurotic disposition by dissipation, sexual or with narcotics, by excessive and prolonged labor, the absorption of poisonous substances, as lead, arsenic or phosphorus. Rapid changes of temperature bring on visceral disturbances. (b) We also take into account sex. It is difficult to say which sex suffers the most from visceral (abdominal) neurosis. I should judge women do. But different varieties of visceral neurosis prevail in each sex, and at different periods of life.

(c) The chief age of visceral neurosis is from 20 to 60. Few cases occur before 20 and rarely after 60. (d) The sexual life of woman is rich in visceral (abdominal) neurosis at different periods as 1, at puberty; 2, at the menopause;

3, at the menstrual period; 4, during pregnancy; 5, in the puerperium; 6, there are neuroses from excess of abstinence of venery. In the above six factors the circulation plays an important role. In short, the neurosis is secondary to some other process.

(e) Visceral (abdominal) neurosis is commonly associated with genital malnutrition, as in anemia, cachexia from malignant disease, chlorosis, debility, mental or physical, from irritation, reflex action, over-strain. Diabetic, gouty and rheumatic persons suffer from visceral neurosis. In the above factors reflex irritation plays the chief role.

(f) In the etiology of visceral neurosis we must include all kinds of trauma to nerves, contraction of cicatricial tissue, pressure of adjacent organs, tumors and pressure on nerves, adjacent inflammatory tissue, dislocated organs dragging as in visceral ptosis; in short, trauma, pressure and dragging.

(g) Many visceral neuroses rest on infection or intoxication, as malaria, typhoid fever, lead, copper, mercury and other agents.

(h) Catching cold, rapid changes of temperature, cold and wet weather, play a role in the etiology of visceral neurosis.

(i) Visceral neurosis may depend on 1, a small abdominal brain; 2, deficient blood supply; 3, continued disease: 4, premature senility; 5, temporary invagination of the bowels.

(j) A peculiar affection of the rectum of a neuralgic character sometimes arises. It occurs in robust as well as neurotic persons. The patient will go to bed well and wake up at any hour of the night, with a severe pain in the rectum, about the large prostatic plexuses of man and about the cervico-uterine ganglia of woman. I know one patient who has had such an affection for over ten years. The pain rises to a maximum and remains intense, gnawing and grinding for from ten minutes to nearly an hour, when it will suddenly pass away. No cause can be assigned in this case, for the patient lives in apparently perfect health.

The symptom, par excellence, of visceral neurosis, is

pain. The patients describe the pain in manifold ways as boring, dragging, burning, stabbing, pressing, lancinating, grinding and tearing. Usually the pain is paroxysmal, ceasing in the intervals. The pain on lessening may be very irregular, slight or intense.

One point in neuralgia (visceral or otherwise) I doubt, and that is that the nerves have distinct, local points of tenderness; Dr. Valleix's announcement, for example, the three tender points on the intercostal nerves. But by careful examination and an opportunity to compress the nerves, we would likely elicit pain in any or all points of a neuralgic nerve. The patient can scarcely give distinct localities of tenderness, for mechanical pressure elicits distinct pain. The irregularity of the various localities of pain in visceral neuralgia shows that it is not a mere local disorder but some germinal malnutrition of the sensory apparatus. Visceral neuralgia not only occurs in the trunks but branches of nerves, as some patients will complain of pain in various regions of the hypogastric trunks but irregular pain in the spermatic branches or in the testicle. During the attacks of visceral neuralgia various accompanying secondary affections arise, as vaso-motor disturbances, muscular disturbances. The vessels contract, lessening the amount of blood passing through them, and muscular action brings contractions (colic) in local and remote regions of the abdomen; shifting, colicky, cramping pains characterize the visceral neuralgias. In one patient on whom we operated the second time, complaining of varying pains in the right side, we found the liver and stomach prolapsed considerably. Since the operations she complains of irregular pains still in the right side where we made no interference. We did not operate for pain in the right side, but for other reasons, yet we noted much visceral ptosis of the stomach and liver in the region of these neuralgic pains. In many cases I have noted the evil effects of peritoneal adhesions previous and subsequent to abdominal section, and Dr. Lucy Waite and I have now operated on over a dozen patients a second time for the pain caused by peritoneal adhesions, fixing movable viscera and interfering with their function rhythm

and peristalsis. Peritoneal adhesions produce as symptoms a kind of visceral neurosis, however; the pain of peritoneal adhesions is certainly more constant, in the language of the patient, as, dragging sensation repeating itself on prolonged efforts. Another patient complained of a varying pain along the left ovarian plexus, and again for months in the region of the left kidney. Physically, nothing could be discovered except that she was very anemic. I am thoroughly convinced that considerable visceral pain arises from pressure of fecal masses as they pass over the nerve plexuses, also that the hard, irritating fecal masses stir up local bowel contractions (colic) as they move toward the rectum. This accounts for the clinical fact that the visceral neuralgic pains fast disappear when cathartics are so used as to regulate a daily stool. In my practice of gynecology nothing has produced better results in constipation than the drinking of a full glass of water and with half a teaspoonful of epsom salts on retiring to bed, and going to stool promptly after breakfast every morning. The more I practise gynecology and abdominal surgery the more I become acquainted with visceral ptosis and its evil results, and the more I am convinced that visceral neuralgia has a physical basis whose pathology will become more manifest with study.

It is difficult to point out precisely symptoms of visceral neuralgia, for the very simple fact that we do not yet know the definite functions of the visceral nerves. We must compare the visceral neuralgia with the better known neuralgia of the trigeminus. It has been stated that neuralgia is a prayer of the nerve for nourishment or for fresh blood. We often notice that a nerve subject to neuralgia is sensitive to pressure. So in our diagnosis we must follow the track of sensitive nerves in the abdomen. To do this we must know that there are great bundles or trunks of nerves called plexuses which follow quite generally large blood vessels. Great ganglia exist in different localities of the abdomen, which space forbids even naming. In short, we have to deal with the abdominal brain, the inferior mesenteric ganglion, the cervico-uterine ganglia and the lateral chain of

ganglia and hosts of smaller ones, all connected by nerve cords. The sympathetic nervous system which supplies the abdominal viscera is partly independent of the remainder of the nervous system and partly intimately connected with its ganglia by fibers from the brain and cord. The ganglion fibers are the greater part motor and innervate the involuntary muscles of the viscera. We deal with the nervous system of the abdomen as composed of the (a) lateral chain of ganglia, (b) the abdominal and pelvic splanchnics (c) the rami communicantes; (d) the vagi nerves, and (e) the abdominal brain with all the nerve ganglia. We have but space to mention the special forms of neuralgia which have been attached to different abdominal organs under the general term of visceral neuralgia. Some of the following forms of visceral néuralgia have gained a place in medical literature:

1. Hepatic neuralgia, or colica hepatica non-calculosa.
2. Neuralgia of the stomach, or gastralgia.
3. Enteralgia (colica mucosa Nothnagel; or better, secretion neurosis of the colon).
4. Ovarian neuralgia.
5. Neuralgia rectalis.
6. Neuralgia renalis.
7. Tubal colic.
8. Uterine neuralgia.

Hepatic neuralgia rests on the view that pain of a neuralgic character arises in the liver region when gall-stones do not appear in the stool nor are found in the autopsy. Andral, Budd, Frerichs, Furbinger, Durand, Bardel and Schüppel are names representing belief of hepatic neuralgia with no calculus as a cause.Gastralgia has been so long in medical literature that it need not be supported by any names. Enteralgia in its various indefinite forms is seen by gynecologic practitioners frequently.

Ovarian neuralgia is a disease glibly talked about, but very difficult to diagnose. I have listened perhaps hundreds of times to descriptions of patients' suffering which some would designate ovarian neuralgia. Yet women do have irregular pain, slight and intense, in the ovary. The ovary

will be found sensitive and painful on pressure. It is the opinion of the writer that so-called ovarian neuralgia is a secondary process, and yet it doubtless exists, as certain as neuralgia of the upper division of the trigeminus. Neuralgia of the rectum has a definite existence. It comes and goes with great irregularity, arising chiefly at night and appears in persons of apparently robust health.

Neuralgia of the kidney rests on the fact that pain occurs in the region of the kidney; the kidney is sensitive to pressure, and no stone has been found in the kidney at the autopsy. The pain has been so severe that nephrectomy was performed, but the kidney contained no stone. In one patient who had pain and tenderness in the region of the kidney for three years I performed the operation of incising the kidney. No stone was found, but an old scar existed in the kidney pelvis, and also opposite to the scar in the kidney there existed a mass of old cicatricial tissue as large as a plum. The conclusion was that a stone had once ulcerated through the pelvis of the kidney and that she was suffering from the cicatrix in and about the kidney.

Tubal and uterine colic, or so-called neuralgia, rests on their peculiar structure. Their involuntary muscular walls, being supplied by sympathetic nerves, are liable to be set in motion by various forms of irritation, and hence from tonic and clonic spasms of their walls are liable to give rise to irregular flying pains or visceral neuralgia.

HYPERESTHESIA OF THE SYMPATHETIC.

"Surmises are not facts. Suspicions which may be unjust need not be stated."—*Abraham Lincoln.*

I. Hyperesthesia of the Abdominal Brain (Neuralgia Celiaca) consists of a sudden violent pain in the region of the stomach. The pain is accompanied by a sense of fainting and impending anxious dread. It manifests itself, objectively, chiefly in the circulation and facial appearance. The skin is pale, the extremities cold, the muscles assume vigorous contractions, especially over the abdomen, and the heart beats under tension and may intermit. The abdominal muscles are put on a stretch. Some patients

are occasionally relieved by pressure on the stomach. From the intimate and close anatomical connection of the abdominal brain with all the abdominal viscera, and also the thoracic viscera, various other symptoms of a similar character to neuralgia celiaca may and do arise, as disturbance in the action of the heart and of the gastro-intestinal tract. The attacks are irregular, periodical, uncertain in time and intensity. The attack may last a few minutes to half an hour. The attack may disappear slowly or under a crisis of perspiration, emittation of gas, vomiting or copious urination, leaving the patient apparently very exhausted. The peculiar characteristics of the attacks in the abdominal brain determine neuralgia celiaca from inflammatory processes of the stomach.

The most typical neuralgia celiaca ever coming under my notice was (1890) that of a man about 40, a real-estate dealer, in whom it had persisted for perhaps ten years. I could discover no gall-bladder trouble or heart trouble, and no stomach lesion. He was attacked, irregularly, however, depending on over-exertion, several times a year. When attacked he felt that impending death was at hand. He screamed between paroxysms and would fall on the floor, rolling in agony for a half or three-quarters of an hour. He anticipated the terrific attacks by preparing for them with great care of his health. He would be very quiet for one or two days subsequent to the attacks; otherwise he was quite healthy. I soon lost sight of him.

The second most typical case of neuralgia celiaca in my practice was that of a woman (1883) about 28. She had very severe and frequent attacks which lasted some fifteen minutes; seemed to have terrible dread and anxiety, a wiry, small pulse, rigid abdominal muscles and varying pupils during the attack. She appeared greatly relieved by pressure directly on the stomach during the attack. She recovered with much exhaustion and relaxation; otherwise she appeared well. She died of ventral carcinoma some twelve years later. Neuralgia celiaca may exist in very various degrees of intensity and duration. In some very severe

attacks it would seem from appearances and the patient's report that the suffering was more profound than an ordinary death. The chief valuable treatment consists in securing active secretion of the skin and kidneys with free bowel evacuation. General tone is secured by tonics and wholesome food; even temperature and quiet life tells the rest ot the story. The treatment during the attacks is purely expectant—sedative and stimulant. Vigorous baths and wholesome suggestions are valuable. There is often more in the advice given with the medicine than in the medicine itself.

Neuralgia celiaca resembles angina pectoris more than any other neuralgia of the sympathetic ganglia. It requires judgment and skill to diagnose it from some forms of angina pectoris, and its treatment is equally doubtful. Of course, it is physical lesions which we suspect in neuralgia of the abdominal brain, as the physician cannot consent to the view that a machine (the sympathetic ganglia) may go wrong without it becomes structurally defective somewhere. Electricity, massage and cold packing are quite effective. Some writers consider this subject under the terms gastralgia or gastrodynia. But under whatever term it may be discussed, the peculiar sense of fainting, the anxiety, dread and feeling of impending destruction of the very center of life itself during the attack, and especially its action on the vascular system, sufficiently characterize it as neuralgia of the abdominal brain—neuralgia celiaca. The diseases of the vagus manifest themselves otherwise.

2. Hyperesthesia of the mesenteric plexus (Neuralgia Mesenterica, enteralgia, enterodynia or colic) signifies pain in the region of the bowel supplied by the nerves accompanying the superior mesenteric artery, i. e., the region of the small intestine and the large bowel from the appendix to the splenic flexure. The pain is irregular, dragging, sickening, pinching, boring, accompanied by a sense of tenderness over the abdomen. The pain shifts from one segment of the bowel to another. The pain is generally located below the umbilicus and alternates with intervals of cessation. The pain does not generally begin suddenly, but gradually

ascends to a maximum. It may be so severe as to induce a sense of faintness. Some patients assume positions to ease the pain, as pressing the hands on the abdomen, bending the thighs on the abdomen. Some patients are very restless under the attacks. The abdomen may be distended with gas or retracted. The attack may pass off with crisis of the passage of gas, vomiting, sweating, profuse urination. The attacks last from a few minutes to several hours. Some patients are subject to these attacks for some months in succession. The patient may have intervals of entire freedom from the attacks. Yet the general observation is that constipation characterizes patients with mesenteric neuralgia. It is understood here that the pain does not arise from a recognizable, demonstrable organic lesion, as ulceration of the mucosa, lesion of the bowel wall or serosa, but from a nervous base. The pain may be merely short, sharp twinges, which some neurotic women describe year in and year out. The clinical picture of the disease offers manifold variations. Some patients have meteorism, pain about the navel, rumbling (borborygmus) in the bowels. Some have gurgling in the intestines, which appears to be due to a sudden irregular contraction of the bowel which rapidly forces the contents onward. In fact, patients with neuralgia mesenterica often possess a catalogue of other neurotic manifestations. Nausea, dysuria and tenesmus may be present. The chief accompaniment of this disease is perhaps constipation. However, the pains of mesenteric neuralgia should not be confounded with those of intestinal colic.

The first author of celebrity who wrote with clear views on the distinction between neuralgia mesenterica and intestinal colic was Thomas Willis (1622-1675), an English physician well remembered by anatomists in the "Circle of Willis," in numbering the cranial nerves and in the nerve of Willis (the spinal accessory). Willis observed over 230 years ago that mesenteric neuralgia was not a disease, but merely a symptom. He said it should be distinguished from the vulgar term, the gripes (intestinal colic). Willis also noted what others see to-day, that the more violent attacks of mesenteric neuralgia generally have regular periods and fol-

low the changes of the weather and the season; when once excited, they yield with difficulty to remedies, do not pass off quickly, and may persist for weeks with great violence. In regard to the seat of pain, it may be noted that in the same individual it generally repeats itself in the same region. The nerve tract sufficiently defective to harbor a neuralgia tends to retain the defect throughout life. It may be remembered that the superior mesenteric nerve supplies over 20 feet of small and nearly 3 feet of large intestine—a vast area—and besides, the small intestine shifts very much daily; hence, the pains of mesenteric neuralgia may be in the lumbar, umbilical and hypogastric regions. If the pain occurs at the pit of the stomach, it is likely located in the transverse colon.

The clinical picture of mesenteric neuralgia is so manifold in its aspect that it requires the best heads and the finest skill to unravel the complicated symptoms. The differential diagnosis is difficult. In certain cases where the symptoms lessen after the evacuation of peculiarly formed rolls of mucus, there is a mixed neurosis.

Again, the mesenteric neuralgia, while it exists, may be complicated by attacks of asthma, nausea, dysuria, hysteria or other nervous affections, to which subjects afflicted with mesenteric neuralgia are prone. In cases of mesenteric neuralgia, certain regions of the abdominal skin may show hyperesthesia from the connection shown to exist between the viscera and the abdominal skin. Mr. Head, of London, in "Brain," 1894, demonstrated the close relation existing between the nerves of the abdominal viscera and the nerves of certain skin areas. Hence, in cases of mesenteric neuralgia hyperesthetic skin areas on the abdomen may be expected. In the incipiency it may be difficult to differentiate a beginning peritonitis from mesenteric neuralgia. But of worth in such a diagnosis as peritonitis are temperature, pain on pressure on the abdomen, general pain and increase of pain by deep pressure on the abdomen. With time the meteorism, singultus and exudate become more evident in peritonitis. In gall-stone colic tenderness on pressure arises and is localized. Icterus may follow to aid. Renal colic is

differentiated from mesenteric neuralgia by its being localized in the region of the kidney, by its continual radiation along the ureters toward the bladder and testicles, by the severe, dragging character of the pain and by the occasional expulsion of a calculus; yet renal colic in some cases may so simulate mesenteric neuralgia that differential diagnosis is very difficult, if not impossible. This might occur when the renal irritation flashes to the abdominal brain, becomes reorganized and radiates along the vast area of the superior mesenteric nerve. An ulcer in the bowel shows constant localized pain on pressure. The patient's history, the omission of the characteristic periodic attacks, the formation of the stools aid, in diagnosing ulcer of the intestines. It may be impossible to make a differential diagnosis in the incipient stage of the diseases.

The most typical species of mesenteric neuralgia known to the writer is lead colic, colica saturnina. Lead colic is preceded by a stage of constipation accompanied by oppressive pains in the abdomen, chiefly about the umbilicus. Nausea, eructations, destroy the appetite. Pinching, twisting and drawing pains occur with different duration and intensity. The pains are often persistently localized, do not frequently shift, occur in paroxysms. The pains of lead colic, mesenteric neuralgia, are apt to arise to the highest pitch at night and when they lessen are apt to leave annoying sensations, allowing little rest during the intervals of paroxysms. The diagnosis is aided by the patient's occupation, history, association, condition and state of climate. Arthritis, rheumatism and malaria induce neuralgia.

Having established the diagnosis of mesenteric neuralgia, the treatment will refer to a certain extent to the etiology. Older practitioners relied too much on evacuation and opium. Modern practice attempts to correct the malnutrition.

The first symptom of signification in mesenteric neuralgia is pain. The second symptom of importance is constipation. Both symptoms demand vigorous attention. The treatment will first consist in attempting to establish the etiology of the mesenteric neuralgia. It is due to dietetic defects, spirituous liquors, narcotics, intestinal contents, co-

prostasis, colica flatulenta, animal parasites, metallic poisoning, or catching cold.

Or again, is the neuralgia due to general nervous affections as neurasthenia, to an exalted irritability of the bowel nerves and ganglia? Is it caused by hysteria or locomotor ataxia? Or is the mesenteric neuralgia induced by some diseased abdominal viscus reflecting its irritation to the abdominal brain, whence reorganized it is flashed over the vast area of the superior mesenteric nerve, rippling the bowel in whole or in segments? An investigation of the above considerations will influence the treatment.

First, the pain, real or pretended, will demand attention. Opium should be avoided if possible. Valerian, asafetida, i.e., drugs with affect on the sense of smell, influence favorably, but perhaps there is more in the suggestion or advice which accompanies the drug than in the drug itself. I have observed better results from hot, moist poultices (corn meal), making the poultice a foot square and three to six inches thick and applying it over the abdomen. Cold packing of the abdomen in heavy, wet towels often does well. Electricity has good moral and physical effects. A hypodermic of morphine, 1-16 of a grain, is effective. However, we must admit that a good dose of opium, e. g., ½ to 1 grain, works wonders for a time in mesenteric neuralgia. The bromides are slow but effective; however, they generally disturb digestion. K Br should be avoided, as it irritates mucosa and skin frequently, calling up rashes; 20 to 30 grains of Na Br will produce a quiet nervous system, especially inducing restful nights and quiet sleep.

The pain of mesenteric neuralgia being disposed of, the more important subject of the curative treatment should be carefully considered. The most important symptom after the pain is that of constipation. The bowels are indolent and are affected but slowly even by active purgatives. The evacuations are scanty and difficult to perform. The feces are dry, globular in shape and brittle. The patients are distressed by fruitless strainings. It is useless to attempt to cure such patients without a strict and rigid regimen. In the first place, such patients will not drink sufficiently; and,

secondly, they lack a regular hour for evacuation. I have treated scores of patients successfully for the constipated habit by directing that a large tumblerful of water with Mg So 4, half to a dram dissolved in it, be drank every night. Also that the patient be directed to go to stool every morning after breakfast, i. e., after the hot coffee is drank, which aids peristalsis. Direction should be given to eat food which leaves a large bulk of residue, as oat meal, corn meal and graham bread. This residual bulk stimulates the intestines to active peristalsis by contact in every successive segment. Daily passages of the bowel and electricity aid to rouse the indolent digestive tract to normal activity. The constant use of a very small pill of aloin, belladonna and strychnine is very effective. Colonic flushings two to four times weekly, salt water and friction baths, aid nature in restoring lost tone. Change of environment, climate, a sea voyage, but, perhaps better, long daily walks, are beneficial. Horseback and bicycle riding are beneficial.

The course of mesenteric neuralgia as regards life is favorable; the attacks, which vary very much as regards intensity, endure from one to several hours. Neuralgias arise in the sympathetic. Collins demonstrated that the arteries of the abdominal viscera were possessed of great sensibility in which the arteries of other parts were wanting. It is likely that the nerves accompanying the mesenteric artery participate in the reflex irritation, inducing the neuralgia.

Hyperesthesia of the Hypogastric Plexus consists of irregular, periodic pains radiating from the abdomen to the genitals, bladder and down the thighs (including the inferior mesenteric plexus), and in the rectum. The hypogastric plexus passes from the abdominal brain along the aorta, common iliacs, and from the bifurcation of the aorta two large strands pass on to complete the pelvic brain or cervical uterine ganglia. In the female the hypogastric plexus chiefly supplies the uterus and tubes; in the male the prostate and vesiculae seminales. In both sexes it supplies the bladder, along the three vesical arteries and the root of the iliac and femoral. In the female the two large branches of the hypogastric plexus, composed of twenty to thirty

strands of nerves, pass off from the region of the inferior mesenteric ganglion and end distinctly in the pelvic brain situated on each side of the cervix. In the male these same branches, though less in size, pass to the prostate and semen-sacs, but the pelvic brain I have found is vastly smaller in males than in females. Yet a small dog possesses quite a large pelvic brain on the side of the prostate and ending of the vas deferens.

The pain in hypogastric neuralgia must be sought for in the anatomical tracts and periphery of the plexus, which will be (a) in the uterus and tubes, (b) in the bladder, and (c) on the path of the iliaco-femoral arteries (and with the inferior mesenterium), the rectum. Also, since the origin of the hypogastric plexus is inseparably blended with that of the spermatic and hemorrhoidal plexus, we must expect to find more or less pain to occur in the ovaries, testicles, rectum and sigmoid.

So far as I am aware Romberg was the first to describe the hyperesthesia of the hypogastric in 1840. It is a neuralgic affection manifested by tenderness and pain in the hypogastric region. There is a sense of pain and dragging in the pelvis, i. e., in the uterus, tubes, bladder and to some extent the rectum. In women the pain is spoken of as dragging, i. e., as if the uterus was prolapsing. The characteristic pain is paroxysmal, periodic, and is not relieved by changes of position. Structural changes cannot be demonstrated. Since it is not practical to separate the inferior mesenteric plexus from the hypogastric on account of their intimate and close anatomic relations, we will consider that the hyperesthesia of the inferior mesenteric or hemorrhoidal plexus is intimately blended with hyperesthesia of the hypogastric plexus, the periodic, and is not relieved by changes of position spoken of as hemorrhoidal neuralgia or neuralgia of the rectum, of which I knew a typical case for ten years. Neuralgia of the rectum in male or female is of an intense character. It is apt to arise at night in an abrupt or sudden manner and continue from a few minutes to an hour or two. It passes away as abruptly as it arises. It creates in-

tense suffering. The best relief is opium suppositories. Venereal excesses appear to aggravate it. Coition momentarily relieves, but it returns quickly with more intense vigor than ever. In venereal excess the neuralgia may extend with painful exacerbations along the urethra, especially worse after coition.

In the range of the sympathetic, neuralgia is frequently followed by secondary effects, as in disturbed circulation, nutrition and secretion

The treatment of hyperesthesia of the hypogastric and inferior mesenteric depends largely on its supposed etiology. It consists in sedatives and evacuants, hydrotherapy, vaginal and rectal douches, electricity, massage and strict diet.

The neuralgia of the hypogastric and inferior mesenteric plexuses exists almost entirely during sexual life, and especially during its active period, and though no demonstrable structural lesion may be found in the plexus of nerves, yet we must be on the alert to remove all visible physical defects for fear that the neuralgia is the secondary effect of the visible ones. The patient should be treated as well as the disease, for it pertains to the wide moral fields. Some patients, male or female, describe all sorts of pains about the genitals for months, and finally they may suddenly disappear. There is a strange connection, however, anatomically and physiologically, between the nasal mucosa (and the olfactory nerve) and the genitals (and also the rectum). Hence, it may be that valerian and asafetida will be effective remedies. A stimulant such as nux vomica is often very beneficial. The beneficial effects of nux vomica on the hyperesthesia of the hypogastric plexus may be owing to the close relation of the lumbar portion of the spinal cord and the genitals, for nux stimulates the nerves. Some old writers termed the neuralgia of the hypogastric plexus menstrual colic. It must be admitted that many of the neuralgic pains spoken of by patients in the hypogastric regions are obscure and would perhaps fit better in the chapter on visceral neurosis.

In hyperesthesia of the hypogastric plexus we must include, for convenience, the pelvic brain. This is a massive

collection of ganglia similar to the cervical ganglia and the abdominal brain. It is located on each side of the uterus. It doubtless rules the vaso-motors in the uterus, innervates the uterus to a large extent, and is accountable for innumerable pelvic pains and for the irritable and tender uterus which is better considered in the domain of visceral neurosis.

Hyperesthesia or neuralgia of the spermatic and ovarian plexuses has occupied the attention of physicians for over a century. Astley Cooper published a notable work in 1830, and Curling wrote later. Romberg wrote on the subject in 1840.

In the male the spermatic plexuses of nerves extend from the origin of the spermatic artery, in the aorta, to the testicle—a long, quite rich strand of nerves. The pain exists mainly in the testicle and extends to some extent along the plexus, i. e., in the spermatic cord. The testicle is generally slightly tender, occasionally exquisitely sensitive; some subjects feel the necessity of a suspend, and feel unable to live without it. Sometimes movements cannot be tolerated and the patient lies in bed carefully protecting the testicle from trauma or touching the bed clothing. If the testicular or spermatic neuralgia becomes intense the pains radiate down the thighs into the back, irritability of the stomach and even vomiting arising. Spermatic neuralgia generally has a more profound effect on the mind than other similar neuralgias outside of the sexual field. The subjects become melancholic, lose ambition and become full of hopeless forebodings. Many of the subjects have varicocele in various degrees. Spermatic neuralgia attacks man's sexual domain, the most profound and dominating human instinct, and if it persist, sooner or later the mind becomes deeply troubled. The patient becomes really possessed with a sexual mania.

The etiology of spermatic neuralgia is not fully known, but it prevails during the state of puberty and manhood. It is a disease of active sexual life only. Cooper, against his will, removed three testicles for spermatic neuralgia and found the gland to be perfectly healthy. Romberg had a case of spermatic neuralgia where the patient insisted,

against the surgeon's advice, that the testicle be removed; however, eight days later the neuralgia appeared in the other testicle, and since it would be only eight days until his coming marriage, he preferred to retain his last testicle.

I have observed cases of spermatic neuralgia before and after operation, and am opposed to operation unless a palpable lesion exist. In males urethral neuralgia is often closely connected with spermatic neuralgia. Such forms are aggravated by coition, and especially excessive venery. Though urethral neuralgia, like other neuralgias, leaves no demonstrable pathology, yet such cases have frequently had a history of gonorrhea, or excessive venery. The passage of graduated sounds, electricity, washing out the bladder, the prohibition of sexual activity, and local applications, relieve. Some old authors, as Cooper, think that these neuralgias belong to a central irritation, but modern investigations would tend to the view that it is a peripheral irritation.

The subject of ovarian neuralgia is very indefinite. However, it is not intended to deny the existence of such a disease, but the difficulty arises in the diagnosis. It appears to me that the so-called ovarian neuralgia should be brought within the domain of visceral neurosis. For example, every gynecologist of experience has observed an irritable uterus, but it should be designated under the term visceral neurosis and note uterine neuralgia. The pain of so-called ovarian neuralgia passes down on each side of the lumbar vertebrae into the pelvis. The pain is irregular, periodic, exacerbated at the menstrual flow, and generally the ovaries are tender. There are certain women who complain of pains in the region of the ovarian plexuses for years. Physical examination discloses at times very little, if any, physical defects. Yet, by close observation and treatment by heavy douches and boro-glycerin tampons, one will frequently note improvement. The pelvic organs feel more normal than at the beginning, hence we rather favor some form of physical defect, congenital or excessive venery or some pathologic imperfection. With this view, the irritable uterus of Gooch, the most of ovarian and other visceral neuralgia, will be more beneficially considered under visceral neurosis.

Hyperesthesia of the gastric plexus, gastric neuralgia, is generally known as gastralgia or gastrodynia. Much that was said in regard to neuralgia of the abdominal brain applies to gastralgia. Also, it may be better to include many of the considerations of gastralgia in the chapter on visceral neurosis. Gastralgia leaves no visible trace of its pathology. But in gastralgia we may look for perverted function of the stomach, as in (a) sensation, (b) secretion and (c) motion. A typical gastralgia is called up in some subjects by taking ice water just following meals; in others, the gastralgia may occur at any time. The chief conditions under which gastralgia is met induces the conviction that it is secondary to some visceral disturbances, and hence the subject is better placed under visceral neurosis.

The Hyperesthesia of the Cervical Ganglia.—Ganglia of such vast size and possessing so much physiologic influence as the cervical must be considered to be subject to the same disease as other similar ganglia. Those who have studied the sympathetic from clinical, experimental and autopsic grounds, chiefly agree that the main pathology is found in the cervical and great abdominal ganglia. The chief influence of the cervical ganglia is manifest on the eye, vessels of the head and neck and the heart.

The Hyperesthesia or Neuralgia of the Cardiac Plexus (Angina Pectoris, Stenocardia, Heberden's Disease, 1768), is a painful affection of the nerves of the heart. It is so far not anatomically definable, but is undoubtedly connected with the sympathetic nerve.

Angina pectoris is a disease based on no one factor, but depends on a group of factors which appear to have origin in the cardiac plexus. It is characterized bv its marked tendency to recur in paroxysms occasionally of intense severity. In one case, a man fifty years of age attended by my colleague, Dr. O. W. MacKellar, the patient was attacked with angina pectoris and died in six hours. Hypodermic injection of morphine did not appear to give relief. In conjunction with Dr. MacKellar, I performed a postmortem on the patient's body fifteen hours later. I found the heart large, dilated. slight fatty degeneration and the

coats of the coronary arteries a little thickened. The fatty degeneration, the sclerosis of the coronary arteries and the dilatation of the cardiac walls, were distinct enough to be easily observed, but not of a remarkable type.

One of my patients has suffered attacks of angina pectoris for eleven years. Otherwise she has enjoyed fair health. Angina pectoris originates in the circulatory system, which is ruled by the sympathetic.

The lesion of angina pectoris is so variable and uncertain that it is impossible to designate its pathology. The cardiac plexus is so intimately and closely connected, both automatically and physiologically, the one with the other, that each involves the domain of the other. In angina pectoris the cardiac plexus and abdominal brain are in such a state of hyperesthesia or irritability that at any time a terrific attack may arise. The attack comes on suddenly, frequently after some brisk exercise or mental activity. John Hunter died in a paroxysm of angina pectoris, brought on by an altercation with hospital authorities.

The pain begins in the region of the heart, but rapidly radiates in other directions, especially down the left arm even to the fingers, perhaps by means of the nervous tract made by the junction of the intercosto-humeral (second dorsal) and the lesser cutaneous nerve (nerve of Wrisberg). The patient during the attack is profoundly affected. The face shows anxious dread and fear of impending death. The pulse may be small, quick and irregular. Respiration is labored, the face is pale and the patient presents a picture of terrible distress. One of my patients required a couple of days to recover from an attack, fearing a recurrence by any active movement. The attacks of angina pectoris are uncertain in intensity, regularity or even in the organs most severely attacked. Hence, the varying accounts of different observers.

The essential features which we have observed in the attacks are 1, pain in the cardiac region; 2, profoundly anxious feeling of the patient; and 3, disturbed heart action. The disturbed respiration may be due to the terrible pain

accompanying the attack. That the paroxysmal pain in angina pectoris arises in the cardiac plexus we do not doubt, but why it arises there and why it is paroxysmal we can only guess, as we are still doing in other neuralgias. If it were due to ossification of the aorta and coronary arteries and consequent pressure on the adjacent cardiac plexuses of nerves, why does it occur so far apart and in such a paroxysmal character? The sympathetic cardiac nerves come from wide areas, hence varied and widely distinct pain. Each of the three cervical ganglia on each side sends a nerve to the cardiac plexus and there repeatedly anastomoses with the vagus.

There is a form of angina pectoris which has its origin or influence in the abdominal viscera. It is a reflex neurosis. The far-famed experiment of Goltz served as the ground of this view. Goltz's "percussion experiment" consists in tapping the intestines when the heart may be arrested (in diastole). This idea serves perhaps to explain deaths from a blow on the pit of the stomach, i. e., on the belly brain. Hence, disturbance, pathologic conditions in the peritoneal viscera, may produce angina pectoris by reflex irritation, through the abdominal brain. Angina pectoris seems to be due to a super-sensitiveness or over-susceptibility of the nervous system. However, Lancereaux found in a case, dying in an attack of angina pectoris, from which he had long suffered, pathologic conditions in the cardiac plexus. So far as I have observed cases of angina pectoris, the chief successful treatment consists in the diligent avoidance of sudden active exercise, physical or mental.

There are some different factors in angina pectoris which may be noted, as (a) spasm of the heart and large blood vessels, (b) a pure neuralgia, and (c) a vaso-motor disturbance produced by reflex irritation. In any or all factors it appears that the sympathetic nerve predominates. The abdominal brain may serve as an irritating factor.

Hyperesthesia of the splenic plexus has not received a description for the reason that it does not produce definite demonstrable symptoms. The plexus of nerves following

the large spiral splenic artery from the abdominal brain to the spleen, lying to the left side between the ninth and tenth ribs, must play a significant role in life's action. The section of the large splenic plexus of nerves begun by Jaschkowitz and others demonstrated that the spleen had something to do with the deposit of pigment in various parts of the body. It is evident that the spleen is not a very active viscus in producing pain. Jaschkowitz showed that irritation of the splenic plexus and branch of the celiac axis lessened the size of the spleen, while ligation of the splenic plexus distended the spleen. The vaso-motor nerves of the abdominal viscera are included in the sympathetic. In several hundred personal autopsies I found the spleen surrounded by peritoneal adhesions in nearly 90 per cent of adult subjects. Hence, it would be difficult to decide whether the pain was not due to the old peri-splenitis. But the spleen is innervated from the same source as the stomach, and there is no reason why the spleen may not suffer from neuralgia as well as the stomach. In regard to the neuralgia of the splenic plexus, it will be required to work it out along the line of experiments, and especially on the vaso-motor nerves.

Hyperesthesia of the hepatic plexus or hepatic neuralgia (diabetes mellitus) is still an obscure subject. The hepatic artery is well surrounded by many strands of sympathetic nerves, and being innervated from the abdominal brain or the same source as the stomach, we see no reason why the liver will not suffer neuralgia pains similar to the stomach. We of course exclude from hepatic neuralgia all pain produced by hepatic calculus or demonstrable pathologic lesion, wherever located—in the biliary ducts, gall-bladder or common duct. Again, pain in the liver might arise from some vicious condition of the bile inducing a form of colic as it passed through the ducts to the intestine, and, besides, this pain would be of a periodic or neuralgic nature. Hepatic neuralgia signifies pain in the region of the liver possessed of a periodic nature. It may be in hepatalgia the tangible cure is overlooked. Inspissated gall may cause excruciating pain in its passage and be found in the stool in dark flakes. The passage of the dry flakes of gall may be

accompanied by severe pain, nausea, exhaustion and vomiting. The right vagus as well as the sympathetic hepatic plexus attends on the liver, so we must view the nerve supply of the liver as mixed, but since the vagus below the diaphragm is a demedulated or sympathetic nerve the final action is the same. It is found that certain injuries to the solar plexus make more blood circulate in the liver, and consequently an increased flow of bile.

Some writers consider there is a causal relation between hepatic neuralgia and diabetes mellitus. It is very evident among writers that there exist two forms of hepatic neuralgia, viz., one accompanied with pain only in the hepatic nerves, and one with pain and the excessive secretion of glycogen (diabetes mellitus).

Dr. Powell records a case of profuse and obstinate sweating with congested liver and diabetic urine. Doubtless the hepatic plexus has power to rule the circulation of the liver to produce congestion and decongestion. Hence, the influence of the sympathetic nerve is very great in diabetes mellitus. It includes hyperemia of the liver, congestion in its capillaries, an influence on the formation of glycogen and perhaps on the ferment necessary for its production. But since the production of diabetes mellitus is a very complicated process we cannot enter into its details. The influence of the sympathetic in diabetes mellitus is observed in the menopause; when the hypogastric plexus is passing through a stage of atrophy women frequently have sugar in the urine.

In this sense diabetes mellitus is identical with hepatic neuralgia. By some irritation transmitted over the hepatic plexus the circulation of the liver is increased, and the glycogen may be excessively formed.

The uncertainty and variability of definite lesions in diabetes mellitus seem to prove that glycosuria may be induced by reflex irritation in the sympathetic. Many physiologists believe that glycosuria is due to hyperemia of the liver. Hyperemia of the liver is controlled by the sympathetic nerve. Just as facial neuralgia, the region of the nerve involved is surrounded by congestion or hyperemic vessels,

so in hepatic neuralgia the vessels of the region of the hepatic nerves are followed by dilation and hyperemia and consequent glycosuria. It is not irritation of the hepatic plexus alone that produces glycosuria; irritation of the sciatic is followed by sugar in the urine.

Hyperesthesia of the pancreatic plexus.—Pain in the pancreatic plexus cannot be located or differentiated from hepatic neuraigia. The late researches of Minkowski would indicate that diabetes mellitus is due to disease of the pancreas. Minkowski and Mevy have done much valuable labor in the field of the pancreas which will aid in solving the problem of the relation of the pancreas to the diabetes mellitus.

Hyperesthesia or neuralgia of the renal plexus, nephralgia (diabetes insipidus) is an affection of the nerves of the kidney unaccompanied by any demonstrable anatomic lesion. The nerves of the kidney are almost entirely non-medullated, i. e., sympathetic. The kidney has the richest nerve supply of any organ in the body except the uterus. The renal artery is abundantly studded with large ganglia, and the nerve strands form a rich network about it. The kidney is closely and intimately connected to the abdominal brain by a large rich plexus of nerves and ganglia. The anatomic and physiologic base for vast influence of the abdominal brain over the kidney is not wanting in abundance of demonstrable sympathetic nerves and ganglia.

Knoll (1871) observed polyuria after division of the splanchnics. He placed canulas in the ureters and then divided one side at a time, so that he could observe the variation. On the side operated on the urine was considerably increased (hyperemia). Some writers claim that neuralgia of the renal plexus is accompanied with excessive flow of urine, polyuria or diabetes insipidus, while others claim that neuralgia of the renal plexus is only accompanied by pain in the nerves of the kidney and no increase of urine. In neuralgia of the renal plexus all renal calculi are excluded.

Neuralgia of the renal plexus is sometimes intense and paroxysmal, while at other times it is more continuous and less severe. The pain does not tend to radiate along the

ureter as it does in renal calculus. It is met with in persons exhausted, anemic, gouty, rheumatic and those poisoned with malaria. Exposure to wet and cold is liable to give rise to renal pain. Sedatives, evacuants, alteratives, electricity and massage are remedies employed against the disease. It is very evident among writers that there exist two forms of renal neuralgia, viz., one with pain only and one with pain and increased flow of urine (diabetes insipidus). With a large sympathetic plexus rich in ganglia, there is no reason, except from experiment, why the kidney should not suffer neuralgia similar to other viscera, as such a condition is recognized in the nerves of the stomach, intestines, ovaries and liver. It is not presumed to exclude cerebro-spinal influences entirely.

However, the renal vessels are ruled by the renal plexus, an almost purely sympathetic apparatus, having its origin in the abdominal brain.

In diabetes insipidus the characteristic feature does not consist in any especial malnutrition of food, but in paralysis of vaso-motor constrictor nerves contained in the renal plexus and consequent dilatation of renal vessels. This allows excessive blood to remain in the kidney (hyperemia). Much of diabetes insipidus depends on the condition of the circulating blood in the kidney brought out by the force of the heart and constriction or dilatation of the renal capillaries. The beneficial influence of ergot in diabetes insipidus demonstrates that the disease has a vaso-motor origin and maintenance

Some writers speak of an idiopathic form of renal neuralgia, which doubtless means that its origin and persistence is not understood. However, as a matter of clinical knowledge, it is very rare to meet with actual renal pain unless there be some pathologic lesion of the kidney or a renal calculus present. But I have met with persistent pain and tenderness in the kidney, which neither urinary examinations nor renal explorations explained.

It is not probable that patients will persist for several years to complain of pain and tenderness (sensitiveness) in the kidney without some real base. I have followed some

for long periods with no discoverable pathologic facts. It is like renal neuralgia.

The Hyperesthesia of the Diaphragmatic Plexus.—This form of neuralgia has not been described as far as I am aware. The diaphragm is so thoroughly dominated by phrenic nerves that it is obscured and overlooked. Yet the diaphragm is distinctly influenced by the sympathetic. Very careful dissection will reveal in the human subject a large nerve connecting directly the inferior cervical ganglion, the ganglion stellum, with the phrenic nerve. Dilatation of the rectum induces the patient to bray like an ass. It induces respiration. In peritonitis the experienced abdominal surgeon views with alarm the incipient sighing and irregular respiration. The diaphragmatic plexus supplies and innervates the vessels of the diaphragm. The ganglion diaphragmaticum exists on the right side only, at the point of junction of the sympathetic and phrenic nerves. The diaphragmatic plexus is connected with the adrenal and the hepatic plexuses. Doubtless some of the sharp pains on respiration owe their origin to the sympathetic in the diaphragm.

CHAPTER XI.

MOTOR NEUROSES.

INTESTINAL MOVEMENTS.

"Our greatest danger now in this country is corporation wealth."
—*Wendell Phillips.*

In experiments on various animals and by clinical observation on man we may note various kinds of bowel movements. For the purpose of making the subject more intelligible we may note that the bowel wall is composed of an outer longitudinal muscular layer and of an inner circular muscular layer. The bowel is lined by a mucous membrane and covered by a serous or peritoneal membrane. The arterial supply is carried from the celiac axis to supply the stomach (gastric artery): from the superior mesenteric artery to supply the small intestines, the ascending colon and transverse colon; from the inferior mesenteric to supply the descending colon, sigmoid and rectum—in all, three segments supplied by three arteries. The nerve supply to the intestines is from three sources:

1. The cranial nerve (the pneumogastric).
2. The spinal nerves, especially those entering at the lower and upper bowel segment.
3. The sympathetic system.

The nerve supply of the bowel is a mixed supply of cerebro-spinal and sympathetic. In the sympathetic nerve supply of the bowel we must name some four sources, viz.:

(a.) The Auerbach plexus, situated between the circular and longitudinal muscular layers of the bowel wall. It is a nerve plexus supplying muscles.

(b.) The Billroth-Meissner plexus, situated under the mucosa. It is a nerve plexus supplying glandular structure and has to do with secretion.

(c.) The abdominal brain (the solar plexus), situated around the origin of the celiac axis and the superior mesenteric artery.

(d.) The lateral chain of sympathetic ganglia, located along each side of the vertebral column. From this chain of ganglia arise the great splanchnics nerves (three or four). With a mixed nerve supply we must designate the character of the movement by the nerve which preponderates. The characteristics movements of the bowel are those of a rhythm, rising slowly to a maximum (spasm) and sinking slowly to a minimum (rest).

The rhythmic, periodic movement belongs to the sympathetic nerve. So that wherever the initiation or prohibition ot motion may reside for the bowel wall, it is dominated by the sympathetic nerve like all other abdominal viscera. With this mixed nerve supply variously localized we may turn to the physiologic movements of the bowel.

1. The peculiar peristaltic movements, which consist of a contraction and dilatation of the bowel lumen. The motion is toward the anus and the contents move in the same direction. The most typical animal which I have examined to study the bowel peristalsis is the rabbit. In the rabbit the contraction and dilatation of the bowel wall is very rapid, traveling a foot in a few seconds. Of course this rapid traveling cannot force the feces with it. The analward wave is transmitted from one segment of the bowel to the other in rapid succession. But with the abdomen open and the bowel struck or pinched or irritated, we must think of very successive physiologic action. The peristalsis borders on pathologic conditions. In fact, one can really see that the bowels move in a wild, irregular confusion. By pinching the bowel wall with the finger and thumb or forceps a circular constriction will arise which resembles a pale, white ring, almost closing the bowel lumen, and persisting awhile This analward alternate contraction and dilatation of the bowel wall is a physiologic process of the bowel, and doubtless is not accompanied by pain unless there be a diseased segment, when pain may arise. The peristalsis of the bowel is perhaps limited to a bowel with

contents, i. e., its contents, or, in other words, mechanical irritation that produces physiologic peristalsis. In laparotomy if one will observe, the empty bowel is nearly always still unless irritated by manipulation. If one will watch the bowel waves of peristalsis it will be apparent that the peristaltic waves are limited to three to twenty-four inches. A peristaltic wave will start and stop within a localized space. In the dog the peristaltic wave is neither so rapid in its travel nor does it seem to travel over such a long distance. The intensity of peristaltic waves is most marked toward the upper end of the jejunum when the muscular fibers, blood and nerve supply are large. The bile and pancreatic duct pour their contents into the upper end of the bowel, and thus impel the peristaltic waves to force the contents downward. For secretion or the presence of any bowel contents is what induces peristalsis.

2. Another form of bowel movement may be called the pendulum movement. This is a contraction and elongation of the longitudinal muscular layer which does not propel the contents analward. The lumen of the gut remains the same. The pendulum movement of the bowel is localized and limited to short stretches of intestine.

3. A third kind of bowel action is described by Professor Nothnagel as a roll motion. Though recognizing Dr. Nothnagel's keen observing powers, I cannot see anything in the roll motion of the bowel except an excessive physiologic, or, better, a pathologic process. It is, in my opinion, only a wild or stormy peristalsis; when, for example, the blood contents, gas or fluid, go onward by spells or jerks. The roll motion doubtless includes those peculiar gurglings which every individual now and then experiences. And though this form of bowel motion is not accompanied by pain, yet it seems to border on the pathologic lines. Of course almost all bowel motion of any distinct type belongs to the small intestines. Perhaps one can scarcely ever observe the large bowel motion through the abdominal wall if it be in a physiologic state. Perhaps the roll motion of the bowel described by Nothnagel is due to an irregular action of the nerve supply, the movements of which, as Auerbach's

plexus, may become disordered. Formerly I thought that the large bowel did not share but a very small part in the excessive activity of blood motion, but recently I found a two-inch "invagination of death" in the ascending colon ot an adult, so that the colon engages in the wild, disordered motion of death when the cerebro-spinal system has lost control forever of the bowel motion.

Peristalsis of the small intestines does not consist of waves starting at the duodenum and entering Bauhin's valve, but the small peristalsis consists of local waves which start and cease within perhaps six inches to two feet. One may recognize peristaltic waves in the same animal two to three or four feet apart, each going through its wave. Now it appears that bowel contents cause the excitants of bowel peristalsis, and even if one observes a full bowel quiet, it does not necessarily overthrow the idea that bowel contents alone excite bowel peristalsis. Empty intestines are still unless excessively stimulated. We must look for the primary anatomical point of motive force of the bowel muscles in Auerbach's plexus. Among the very unsatisfactory experiments are those attempting to find out the location of a nervous center for bowel movement. Pflueger discovered that when the splanchnics are stimulated the bowel motion is prohibited, the bowels become pale and the blood vessels become narrowed (anemic); but severing the splanchnics induces increased bowel peristalsis, the bowels become more filled with blood and congestion occurs. Some assert one thing and some assert another in regard to the influence of the vagus over the intestinal motion.

Ludwig, Nasse, Kupffer, Mayer and Borch found in the splanchnic prohibitory and vaso-motor nerves, besides nerves which, by stimulation, irritated motion in the bowel. Also Mayer and Borch could, by irritating the vagus, prohibit intestinal movement. Borch and Ehrmann believed from experiments that the splanchnics were the motor nerves of the longitudinal muscular layer and the prohibitory to the circular muscular layers, and that the vagus stirred up the circular muscles while it prohibited the longitudinal muscles. Fellner claims that he found the nervi engentes to be the

source of longitude. muscular action, while the hypogastric nerves were the motor nerves for the circular muscles. Lately Steinach claims that the motor innervation of the intestinal tract is through the posterior sensitive roots of the spinal cord. The portion of the colon supplied by the inferior mesenteric artery, i. e., the descending colon, sigmoid and rectum, have an analogous supply to the upper portion of the digestive tract. The nerves from the spinal cord pass through the round communicantes, onward through the lateral chain of sympathetic ganglia into the hypogastric plexus mesentericus inferior, which plexuses supply the sigmoid, rectum and descending colon. The lumbar region was proven by Goltz's experiment to have a motor center for the rectum. In this case the spinal nerves course through the hypogastric and mesenteric plexuses to act as motor nerves for the bowel. The sympathetic nerves and ganglia, the unconscious motors of the assimilating laboratory, work steadily on while the digestive tract has any contents. It is entirely analogous to the uterus. When there exist contents in the uterus its walls pass and repass through constant waves, but if it is empty, it is quiescent, it is still. So it is with the bowels, an empty gut is still a quiet one; a full one is nearly always in motion.

Anemia of the intestines lessens the peristalsis while hyperemia increases the peristalsis. Chemically indifferent substances will create bowel motion according to their deviation from the normal bodily temperature. It must be remembered that over distention makes contraction impossible, i. e., tympanites is paralysis just exactly according to its degree of distention. Tympanites is accompanied by slight peristalsis but the pain is due to local spasm, especially of the circular muscles. It appears to me that the circular muscles of the bowel can so obliterate the lumen that it practically prevents all passage of contents. Doubtless the muscles would sooner or later tire out and admit of the passage. We may say that it is extremely rare to observe the physiologic bowel peristalsis through the abdominal wall. But it is not at all rare to observe the bowel peristalsis through the abdominal wall in a pathologic state. In the

normal state the abdominal wall is so thick, and the change of shape and form of the gut is so slight that one can seldom definitely mark out bowel peristalsis. In belly walls thinned by wasting disease and muscles thinned and separated by the stretching of the walls one may map out moving bowel coils very easily. Especially is this the case in bowel obstruction.

Peristalsis of a pathologic character may be (a) increase, (b) tonic contraction and (c) the so-called antipendalis. The rolling motion of the bowel described by Prof. Nothnagel, I would call pathologic. If one will open dogs with peritonitis there may be observed irregular bowel movements; sharp contraction of both longitudinal and circular muscles. In fact the peristalsis has become irregular, excessive, wild. The slow, normal, pendulum movements of dilatation and contraction of gut have been displaced by violent movements. The bowel movement or peristalsis is accordingly violent and wild as the bowel wall is inflamed. One may observe increased bowel peristalsis from (a) irritating foods, (b) from strong doses of physic, (c) in sudden mental disturbances, (d) in neurotic patients, (e) from hot or cold fluids, drinks or foods, (f) in enteritis or peritonitis, (g) especially in intestinal stenosis, (h) the absorption of lead into the system, (i) exposure to cold. It did not appear to me that traveling of dogs increased the peristalsis, yet in general motion aids to increase peristalsis. The important tetanic bowel contraction is significant for in experiment one can observe by pinching a piece of bowel it will contract into a pale white cord, perhaps entirely closing the lumen for all practical purposes. The tetanic contraction slowly yields its spasm, but doubtless is accompanied with terrific pain. For almost every drop of blood is driven out of the gut wall and the nerves are pressed in a traumatic state. If neuralgia is a demand for fresh blood, surely this is a typical example.

Doubtless in the violent pain of lead-colic (colica saturnina) the gut is contracted to a white rod and the condition of persistent pain depends on various segments being successively attacked. Tonic contraction of the gut-wall is a frequent condition of bowel stenosis. If one will sit down

by a patient with sufficient bowel stenosis to produce obstruction of the bowel contents, by placing the hand on the abdomen he can easily perceive the bowel movements, because in such patients the belly wall is usually thin. The bowel movements are almost constantly felt, they gradually increase until the small intestine may feel as hard as a rolling-pin under a sheet, and such a hard bowel will gradually relax, when the same phenomenon will appear elsewhere. It is quite probable that progressive peristalsis is not accompanied by pain, no matter how lively it is. But tonic or spasmodic contraction of the bowel can be and is accompanied by the most sickening pain. The chief pain from the bowels (colic) no doubt arises in disturbed or disordered peristalsis. Local inflammation in the gut producing an irritability of the peripheral nerves induces irregular, disordered and wild bowel contractions with severe pain. Much has been said by writers in regard to antiperistalsis, i. e., a peristaltic wave directed toward the pylorus instead of toward the anus. I have studied this subject considerably in an experimental method, but have never been able to see distinctly anything but very irregular anti-peristaltic waves. I tried Prof. Nothnagel's claims that sodium salts made antiperistalsis and potassium salts induced peristalsis, but after several trials on dogs to test the direction of the gut I could not consider it of any practical value, neither could I confirm his assertions. After laparotomy we observe frequently considerable pain and almost always accompanying this pain there is more or less tympanites. The pain is due to irregular contraction of the gut wall. Segments of the bowel become over distended, which is a kind of partial paralysis and it cannot again contract. This distended portion does not give pain. The pain arises from the non-distended or partially distended segments which are in a state of spasm, irregular contraction and with irritable peripheral nerves.

Excessive or irregular bowel peristalsis is observed among hyterical and neurasthenic persons. It is recognized by gurgling, splashing or rumbling noises in the abdomen. It arises in neurotic persons, yet the same person generally suffers no unpleasant sensations, except the mental annoy-

ance. The rumbling noise has no especial connection with mealtimes or drinking. If it occurs in women it is apt to be more active at the menstrual time. Mental influences seem to play a role, for when the subject works or directs the mental energies away from the phenomenon, the gurgling generally ceases. If the abdominal walls be thin, one can observe the intestinal movements which are confined chiefly to the small intestines. Other subjective symptoms generally fail; however, gas may be belched. The diagnosis of excessive bowel peristalsis is not difficult if one can observe the patient for some time. The trouble may persist for weeks and normal stools continue curing the whole time. Excessive bowel peristalsis may be diagnosed from bowel stenosis by its spontaneous appearance and cessation.

It seems a characteristic of certain persons to have repeated attacks, and I have observed such attacks for many years in certain persons at certain times, when the mental faculties were either on a sudden tension or embarrassed. It is reported that an old and valuable servant felt obliged to give up waiting on account of repeated attacks of loud gurgling, when she was serving at meal-times.

Excessive peristalsis is generally confined to the small intestines. The treatment of excessive bowel peristalsis should be both physical and mental. Hydrotherapy, massage, galvanization of the abdomen and remedies profoundly affecting the olfactory nerve, aid to bring about normal bowel peristalsis. As remedies the bromides, arsenic, iron and nux vomica are valuable adjuncts. The regulation of the diet is of first importance.

Enterospasm is a condition of the bowel in which the longitudinal or circular muscular layers are in a state of excessive contraction. To see an actual demonstration of this phenomenon, the most practical method is to open a rabbit's or a dog's abdomen and by pinching the bowel wall with the finger and thumb both, the muscular layer will be observed in a state of spasm. The circular muscular layer on being pinched or struck will contract to a small white ring or band. The enterospasm is likely to occur in very limited segments of bowel. If it be primary, it is a motor impulse, but it may

be secondary to a sensory neurosis when it is of a reflex nature. In such a case both a motor-neurosis and a sensory-neurosis exist, that is, a mixed neurosis.

Enterospasm is primarily a motor-neurosis, but is frequently combined with reflex sensory factors inducing severe pain. As a result of the spasm irregular constipation arises. The stool is either long retained or forcibly expelled. Enterospasm may owe its origin to misuse of cathartics, the entrance of lead into the system, mental effects, worms or improper use of foods. Meningitis or disease of the cerebro-spinal axis may play a role.

The treatment of enterospasm consists of opium and evacuants. It is this form of constipation that the old physicians said paradoxically opium cured. It cured the spasm and the bowels naturally became regular. The proper treatment, however, will consist more in diet regulation, colonic flushings, in electrical treatment, in bromides, nux vomica, in massage and hydro-therapeutic measures.

Paralysis of the bowel signifies that the contents are not forced onward through the lumen is patent. No mechanical obstruction exists. Henrot announces three forms. We first have direct paralysis of the bowel from affection of its walls, as after reduced hernia, often trauma, as in laparotomy, after peritonitis, enteritis, etc.

Second we have indirect or reflex paralysis, as from injury to the testicle, inflammation of a bowel segment, as inflammation of the appendix produces paralysis of large bowel segments, the irritation being reflected to the abdominal brain, reorganized and sent out on the various nerve plexuses, laming the said segments. An abscess in the abdominal wall may by reflex action produce paralysis of a bowel segment sufficient to prevent the onward movement of the feces. In many autopsies, experiments on animals or on humans, I have noted where a small perforation had produced paralysis of adjacent segments by spread of peritoneal inflammation. No mechanical obstruction existed. This is what one continually hears of as obstruction of the bowels,—it is really peritonitis. The paralysis is due to

oedema and exudates pressing on the peripheral nerve apparatus of the bowel wall.

Thirdly, by leaving out of consideration the cerebro-spinal lesions we have bowel paralysis from hysteria, melancholia, neurasthenia, from atony of the bowel and from persistent coprostasis. It must be remembered that the symptoms of ileus-paralyticus are not easy to diagnose from genuine ileus. In genuine ileus the peristalsis of the bowel is increased on the proximal side of the affected locality. The therapeutic application for any form of ileus depends entirely on the original cause. Should the paralysis depend on some neurosis, the treatment will be regulation of diet, electricity and massage of the abdomen, the careful use of evacuants and moral influences. Colonic flushings are excellent in this form of neurosis.

Deficient peristaltic action observed in old age and anemic persons depends perhaps much on exhaustion, and deficient blood of a proper composition. Besides deficient peristalsis means deficient secretion and deficient secretion means an empty bowel and an empty bowel means a quiet one. The parenchymal intestinal ganglia require proper blood to stimulate them to action. The peristaltic movements of the bowels are anatomically excited by the distal visceral ganglia, yet they receive and empty feces from the abdominal brain impulses to accelerate or retard the bowel motion.

McKendrick believes the accelerating nerves of the bowel are from the sympathetic ganglia, while the prohibiting nerves are from the lumbar spinal. The descending colon and rectum, according to Nasse, receive motor fibers from the plexuses of nerves surrounding the mesenteric artery. The general notions (Fox, McKendrick, Nasse, Bridge, Kolliker) are that the gastro-intestinal ganglia send motor fibers to the bowel muscle and that these automatic ganglia are stimulated reflexly by fibers running from them to the mucosa (Henle). Hence, a diarrhea is a reflex matter. Pflueger believed that the splanchnics were inhibitory nerves of bowel action, but Bosch showed that the splanchnics were inhibitory nerves only in a secondary

manner by changing the circulation in the bowel. The motus peristalticus in lead colic is of much interest, as it should lead to the source of bowel motion, but the special action of lead on tissue is not yet settled. However, it belongs without doubt to the abdominal sympathetic. Is the disturbance due to the action of the lead on the sympathetic ganglia? Does the lead act as an excitant on fibers of the splanchnics? Both views may be retained until more precise data exist. Begbie asserts that irritation of the abdominal brain (or as he says, plexuses surrounding the aorta) induces active movements of the small intestines and colon. Valentin discovered that irritation of the fifth nerve produces invariably movements of the small intestines. We must remember that the fifth nerve is par excellence the ganglionic cranial nerve, having eight ganglia situated on its branches. It is really a sympathetic cranial nerve. It is not yet clear what is the influence of the cerebro-spinal system over the movement of the abdominal viscera, but observers are agreed that fear, fright, emanations, intensely influence the bowel movements, showing the influence of the cerebro-spinal axis on the bowel and sphincter. How much is this due to relaxation of sphincters? As Romberg remarked fifty years ago, the field of influence of the cerebro-spinal axis over bowel movement is not fully known. From personal experience we know that ordinarily the passing form of colic, bowel spasm, is due to irritating contents. The irritation of the mucosa passes to the automatic ganglia of the bowel wall which resents the trauma by muscular contraction; the resulting consequence is pain.

The motor bowel, automatic parenchymatous ganglion, is one of the best samples to illustrate the highest degree of independence. The influence of the sympathetic nerve upon the intestines has long been recognized. The long controversy in relation to the influence of the great splanchnic nerve upon the small intestines seems to be more definitely settled. Weber showed some years ago, that the splanchnic exerts an inhibitory action upon the intestines, arresting their movement. Legros and Onimus, however, claimed to show by their experiments that the splanchnic is on the

contrary, the motor nerve of the intestines, and, when stimulated, produces contraction of the intestinal walls.

Recent experiments made by Coutade and Guyon present very clear evidence that the two muscular layers of the intestine are controlled by nerves of a different origin, the circular layer being controlled by branches of the sympathetic, and the longitudinal by the spinal nerves. The conclusions arrived at by these investigators are as follows, to which all experimenters do not agree:

(a). The sympathetic causes contraction of the circular muscular layers of the intestine, and at the same time, relaxation of the longitudinal muscular coat.

(b). The contraction of the small intestines depends entirely upon the sympathetic, and is wholly independent of the pneumogastric.

Galvanization of the abdominal brain induces active movements of the small intestines and to a certain degree of the large. Anatomic and physiologic experiments certainly show that branches of the abdominal brain take part in the innervation of the stomach.

There is a certain kind of excessive bowel peristalsis which is disastrous at any age, but especially in infancy. I refer to invagination. One-quarter of all invaginations occur before one year of age, and one-half of invaginations occur under ten years of age. Invagination, telescoping, intussusception, is where one segment of bowel is driven into the adjacent one. Nearly all invaginations are toward the anus downward, but some report invagination toward the stomach upward. Hektoen reports a case of upward invagination. Invaginations are especially apt to arise in two classes of subjects, viz.: (a) in children and (b) in persons dying of some cerebro-spinal trouble. The invaginations found in autopsies may be called the invagination of death. I have repeatedly found this condition in human and animal autopsies.

The characteristics of the invagination of death are that they are accompanied by no inflammatory process, no exudates, no congestions or peritonitis, and are often multiple. In one dog, dying of peritonitis, I found four points of invagination close to each other. They were invaginations of about

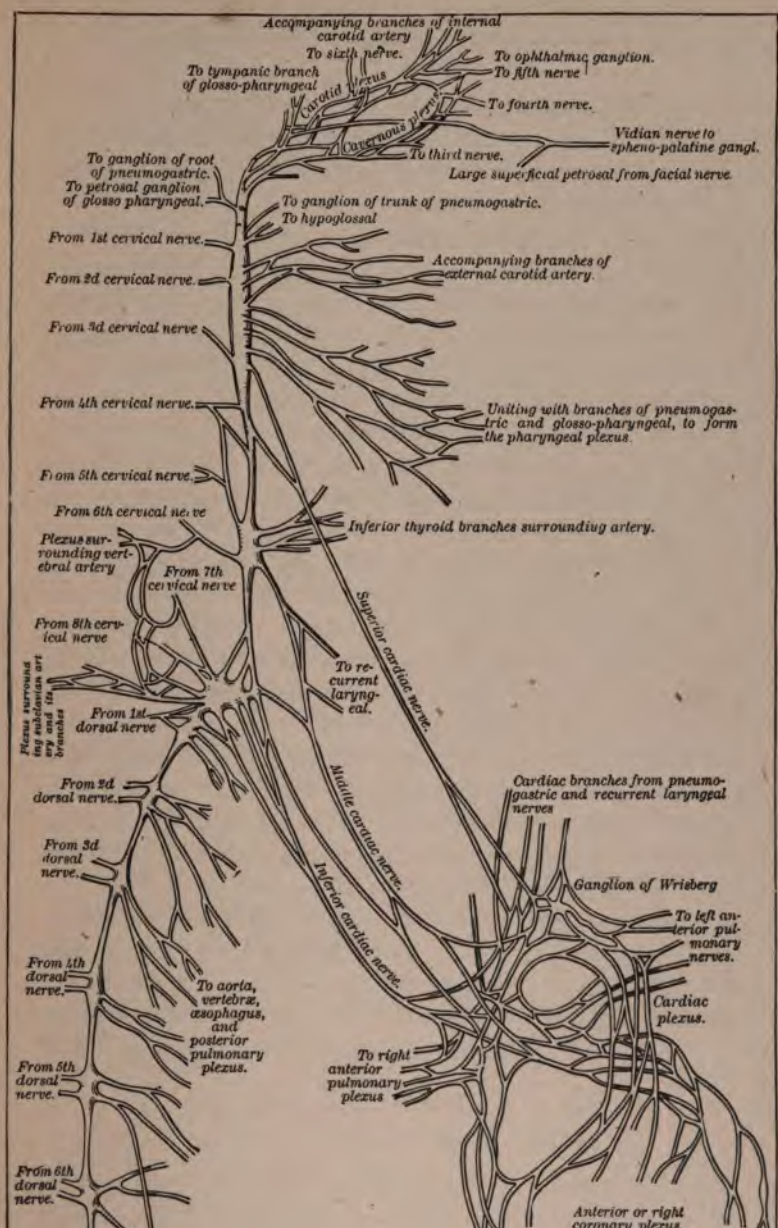

Figure 16.

Plan of the cervical portion of the sympathetic. (After Flower).

an inch distance each. Several times in human autopsies, I have found from one to four points of invagination. The characteristics of ordinary invagination are that it is accompanied by severe and sudden pain and if continued long enough by congestion, exudation and inflammation in the bowel tunics. Finally, the apex will begin to bleed and slough, producing bloody stools and finally peritonitis; and its results are found about the point of invagination.

Invagination is due to irregular action of the muscles in the gut-wall. It is due to irregular peristalsis. In children and persons with diseased cerebro-spinal system it appears that the cerebro-spinal axis, the higher nerve center, has lost its normal control over the sympathetic which rules the bowels and the result is that the intestines assume wild and disordered movements. Not only the bowel segments but their longitudinal and circular muscles begin to act without harmony, irregular, spasmodic. In infants and children it appears that the cerebro-spinal axis has not assumed full control over the sympathetic which rules the bowel muscles. Since invagination constitutes one-third of all forms of intestinal obstruction regular action of the gut wall assumes an important role. It is curious to note the common localities of invagination. The ileo-colic and ileo-cecal constitute 50 per cent, i. e., 50 per cent of invaginations occur at the ileo-cecal valve. Thirty per cent occur in the small intestines and 20 per cent occur in the colon. Leaving out the region of the ileo-cecal valve as having some mechanical peculiarity tending to invagination, we note that there are more invaginations in the small intestines than in the large, which must be due to greater possession of muscles.

INTESTINAL SECRETION.

"It is our hearers who inspire us."—*Vinet.*

1. Gastro-intestinal secretion is a significant and important matter in animal life. Gastro-intestinal secretions are under the control of the sympathetic ganglia located in the walls of the digestive tract. We designate those ganglia in general as the Billroth-Meissner plexuses situated immediately beneath the gastro-intestinal mucosa. They rule secre-

tion. We cannot properly separate the submucous nerve plexus from the Auerbach's plexus which rules muscular motion and is situated between the crucial and longitudinal muscles of the gastro-intestinal tract. One nerve plexus is a complement of the other. As secretion without motion is of little avail, and motion without secretion is equally futile, peristaltic motion is necessary to sweep onward the food to be attacked by fresh glandular secretion and to eliminate, drain, the system from the debris of food. The remnants of the gastro-intestinal feast must be removed by peristaltic movements.

Besides, secretion is doubtless enhanced by muscular contractions. The large degree of independence exercised by the sympathetic ganglia, especially at a long distance from the cerebro-spinal center, is quite suggestive that there will be local as well as general gastro-intestinal mucous secretion. From the very construction and function of the digestive tract we may expect local labors in it. At several localities new and different secretions are added to the onward moving food, so that local and general digestion and secretion must occur. I repeat that secretion and digestion are both local and general in regard to the digestive tube. Yet the whole nerve apparatus of the digestive tract is a delicately balanced matter both as regards to muscular and secretory activity. Let us call up matters that daily occur, but are not always interpreted. For example, a person eats some cucumbers or other indigestible and fermentable substance. At the time that the indigestible substance is eaten the bowels may be as regular as clockwork and the feces of semiliquid character. Ten hours after eating the indigestible substance, when the regular stool is to be evacuated, it will be observed that: 1, the stool is delayed, the desire for stool is checked; 2, if forced evacuation be exercised, the stool will be hard and relatively dry, for want of secretion is manifest by distinctly formed and shaped feces.

Now what is the cause of this disturbance? The cause is unbalanced secretion due to reflex irritation. The irritation is going on in the business portion of the digestive tract, i .e., in the small intestines. The subject is conscious of this

disturbance only by a little pain, colic and excessive peristalsis. He, however, notices that an excess of gases is being formed and passed per rectum. He may not sleep well,/but recognizes an indefinable restlessness. This irritation may be active enough to produce seminal emissions during sleep. The irritation in the small intestines has unbalanced the mechanism of secretion, so that it is called away from the large intestine, causing excessive secretion in the small intestine, and hence the dry formed feces in the large. It is very likely that the excessive, deficient or disproportionate secretions may occur in separate localities of the digestive tract, just as peristalsis of the tract may be a local matter. We know from experiment that peristalsis may arise, continue and subside, limited to a short piece of gut.

This view of local disturbance in both peristalsis and secretion sending out its reflex power and disturbing the whole digestive tract is in accord with pathologic data. For example, a perforation of the appendix may so unbalance the nerve apparatus as to feel it at the umbilicus. It is a reality. The secretion of the gastro-intestinal mucosa is entirely beyond the control of the will. In secretions we are especially dealing with the sympathetic nerve, for secretions have a close relation to the size of the blood vessels.

1. All glands receive vessels.
2. All vessels have nerves to control their caliber.

The gastric secretion may be reviewed in regard to experimental data. The stomach is supplied with nerves for its muscles and for its glands, as motion and secretion are both necessary for normal digestion. The arrangement of the Auerbach and Billroth-Meissner plexuses is similar to the small intestines. The splanchnic nerve is the chief vaso-motor nerve, i. e., vaso-dilator and vaso-constrictor. This is important, for secretion in general depends on the blood supply, as may be observed in location in the season of "rut," in glandular congestion. But the gastric glands are ruled by the sympathetic nerves, whose chief origin exists in the abdominal brain.

It must be claimed, however, that the stomach glands can act independently, from sympathetic influence alone, and

also be changed or modified by the cerebro-spinal. It is doubtless true that there are not only vaso-motor nerves in the spinal cord but that the abdominal brain is a great vaso-motor center, in that the abdominal brain regulates the amount of blood to the gastric glands and consequently the amount, and to a certain degree the kind, of secretion of the stomach. Yet there must be secretory nerves in the stomach which belong to the sympathetic. Candor requires the statement that the full knowledge of the nerve supply of the gastric glands is not fully known.

The independence of the sympathetic ganglia of the stomach is signified by the fact that the chief stimulus to the gastric secretion is food in the stomach. It is asserted by some that stimulating any of the nerves going to the stomach does not influence the secretion, for it is found out that secretion will go on under the stimulus of food when all the stomachic nerves are severed. It is claimed, therefore, that the sympathetic ganglia in the stomachic walls are sufficient to act as centers for secretion. This delegates large and significant powers to the sympathetic ganglia.

The sympathetic ganglia are especially liable to reflex irritation, and nowhere is it more manifest than in the stomach. The gastric secretion is modified by reflex stimuli from the brain, uterus, kidney, testicle, ovary, heart and spinal cord, etc., etc. Emotions play a role in gastric secretion.

The successful treatment of stomachic disease is significant in methods of stimulating the stomach, as irritating its mucal wall, which not only start secretion but motion as well. In ordinary stomach diseases there are four factors, viz.: (a) excessive secretion, (b) deficient secretion, (c) disproportionate secretion, and (d) muscular motion. Washing out the stomach, irritating its wall with instruments or coarse food, will accomplish much in inducing health. Doubtless this is the action of nux vomica and hot water. The clinging germs should be washed from the dormant stomach wall and the muscular movements must be stirred up to excite natural secretions. It has astonished me at the frequent beneficial results of irrigation of the stomach. It stirs to more normal rhythm the sympathetic ganglia, both of secre-

tion and motion. Besides, it washes from the stomach wall abdominal matter. The stomach must have rest and repose or it cannot long stand irregular irritation without resentment of the little circulation insults. Hence, the distal irritation from a diseased uterus, tubes and ovaries sooner or later unbalances stomach function by its regular passage of the traumatic insults to the abdominal brain where reorganization occurs, perhaps with multiplication of effects. The excitation of the diseased genitals has no season of rest, no day or night repose, but at any or all times it rushes and flashes, now tumultuous or turbulent, now pell mell and explosive. There is nothing like a chronic metritic uterus to derange, unbalance the gastric secretion and motion.

The stomach is very highly supplied with blood vessels and nerves, because it is a vast and complicated laboratory, requiring much energy to hold its delicate but active processes in the balanced order. From experimental data we may view the stomachic glands as under the control of the sympathetic nerves, i. e., the ganglia in them.

SECRETION-NEUROSES OF THE COLON.

"Thinking is the talking of the soul with itself."—*Plato.*

History notes that Dr. Mason Good gave one of the first communications in regard to the above disease, in 1825, under the name "Diarrhea Tubularis." Woodward collected the literature up to 1879, in the Medical and Surgical History of the War of the Rebellion, Vol. I. Da Costa wrote in regard to the disease, as did also Leyden in 1892. Nothnagel, in 1884, wrote an excellent essay on the disease, naming it colica mucosa. In 1884 Krysinski, of Jena, wrote an inaugural thesis on the disease, detailing six cases, and sought to establish as its cause the presence and effects of micro-organisms. Leube thought it a nervous affection. Pick has recently written a short essay on the subject.

Many different names have been applied to this disease on account of the various views as to its causation. If the disease consists of an epithelial inflammation, a catarrh, we may be satisfied with the designation, enteritis membranacea, but should there exist only increased mucous

secretion, without inflammation, the term colica mucosa would be more significant. However, my studies on the subject have induced me to adopt the term, secretion-neurosis. It is probable that there are two ill-defined affections in this field, one being an enteritis and the other a simple increase of the mucous secretion. Autopsies are so rare on subjects dying of secretion-neurosis of the colon that no pathological basis is as yet definitely established. An ante mortem diagnosis must be confirmed by a post mortem examination before any pathology can be accepted or established.

All observers agree that secretion-neurosis of the colon is indicated by the peculiar formation and evacuation of the stools. The clinical symptoms are colicky pains and the evacuation of masses of mucus. The mucous masses may consist of flat (even membranes) long bands, ribbons, shreds or rolled-up tubes. Some portions assume a spiral form. Some writers assert that the masses are fibrinous, but I have examined quite a number and have never observed fibrin. The mucous masses are white, grayish white, or a color due to the mixing of mucus and feces, yellowish brown. By placing the mucous masses in water they unroll and partially dissolve. However, the peculiar form of the mucous masses may be retained if they are kept in bottles of water for several days, as we have noted in one case. The quantities of these masses evacuated by some patients are enormous. A female attended by Dr. Lucy Waite and myself, would occasionally evacuate nearly half a pint of mucous membranes, masses, bands, tubes or unformed substances. In a male the evacuation showed more string—or ribbon-like processes.

All observers agree that women are the chief subjects of secretion-neurosis of the colon. Litten estimates that 80 per cent are women, and according to Kitagawa 90 per cent are female subjects. Dr. Evans says that of the many samples sent to the Columbus Medical Laboratory 80 per cent are from women.

I had a typical case in a man 36 years of age, who had

the disease for nine years. Some report cases in men and children. I never saw a typical case in a child. Almost all writers agree that women who are subjects of secretion-neurosis of the colon are neurotic, nervous, hysterical or hypochondriac. The men possess a similar neurotic or hypochondriac tendency.

Patients afflicted with secretion-neurosis of the colon have suffered from constipation for long periods previous to the outbreak of the former disease. This accords with my view that constipation is a neurosis of the colon or fecal reservoir. The attacks of such patients are irregular, but recur for years. Pain of a colicky nature may suddenly arise in the abdōmen and continue until masses of mucus and occasionally feces are expelled. The attacks of pain may be extremely severe, especially when large masses of mucus are evacuated. So far as I could discover, the pain is chiefly located in the transverse and descending colon and the sigmoid flexure; in general, over the left abdominal region. However, when the colicky pain is severe and continuous, the patient may complain of pain in the whole abdominal region. Some of my patients complained of pain running down the legs. Abnormal sensation may arise in the genito-urinary organs. After the evacuations of the mucous, slimy masses, especially the larger ones, the patients appear and report themselves to be entirely free from pain. Generally, the larger the mucoid masses evacuated, the longer the patient remains free. However, the colicky pains may be coming on for one or two days before the large masses are expelled. If the evacuation be slight in quantity, the colicky pains are slight, but often continuous. The appetite is generally good, except at the time of attack. An enema will occasionally bring away very large masses of slime. Also, there are patients who pass the mucous masses who do not report nor appear to suffer pain. Hence two classes of patients present themselves, viz.: some pass mucous masses with colicky pains; others pass mucous masses without colicky pains.

Nothnagel, my honored teacher, the ablest of all writers

on the subject shields himself by adopting the term "*colica mucosa ct enteritis membranacea.*" He acknowledges that a variety of pathological processes are here included. Krysinski and Mathieu are both inclined to consider the affection an enteritis and Krysinski endeavors to show that certain low organisms are the primary cause. It does not seem probable that micro-organisms would persist for years; and besides, were the disease caused by micro-organisms we ought to be able to cure it. Krysinski describes patients who simply gave a desire for stool without colicky pains, i. e., merely "bearing down pains."

Much interest is manifested by writers, in the stools in secretion-neurosis of the colon.

Microscopically the evacuation consists of membranous or tubular gray masses. They may resemble croupous membrane from the respiratory passages. The mucous masses may be transparent like slime, or opaque like fibrin, of a grayish white, or a dirty color with pigment in it. Sometimes the masses consist of large, wide and thick leathery-like membranes; at other times, long ribbon-like bands or rope-like coils. The mucous masses nearly always come away alone, unmixed with feces. Sometimes they resemble the swollen jackets of baked potatoes. By careful manipulation in water the masses of slime will generally unfold into membranes; hence the term, membranous colitis. They may resemble fascia or tendons, or one may be deceived by milk coagula.

Microscopically, the mass substance represents a hyaline body, which can be preserved only a short time in air, alcohol or water. Degenerating cylindrical epithelia of almost any grade can be noted. The slimy mass represents a glassy, unformed, transparent substance. If acetic acid be added it assumes a wavy, striped or ground glass appearance. Glandular epithelia are almost always found, shrunken, swollen or vacuolated. Sometimes vast numbers of microbes are present, cholesterin crystals, triple phosphates, fecal masses, pigment and occasionally round cells.

Chemical examination reveals mucin, or mucin-like ma-

terial, as the chief constituent. This may be considered as definitely established, as it is confirmed by Clark, Thompson, Perrond, Da Costa, Hare, Pick, Nothnagel, Furbringer, Hirsch, Walter, V. Jaksch, Krysinski, Kitagama, Rothmann, Littre, Vanni, Leube and Pariser, a sufficient number of investigators to settle the question. Some authors assert that mucin is the chief constituent with other albuminous bodies. The only author we have found who claims that fibrin exists in the evacuations of secretion-neurosis of the colon is P. Guttman, who apparently based his support on doubtful microscopical examination.

Pathological records are rare, on account of the scarcity of material on which to establish them. Nothnagel reports a case of secretion-neurosis; Rothman, one which was examined by C. Ruge. Ruge reported that "in spite of careful examination of the whole intestinal tract, nothing abnormal was discovered." The above patient of Rothman presented a typical picture of colica mucosa, but died from a duodenal perforation.

Rothman had another case that died of carcinoma at the base of the skull. The patient was in the hospital from June 14 to Nov. 2, 1892. By taking an enema the patient evacuated large masses of mucus without pain. He made no complaint. The autopsy showed in the transverse colon (where it did not contain feces) and the strongly contracted parts of the descending colon, injected and folded mucosa. Between the folded mucosa lay products, partly membranous, partly strand-formed. The parts of the colon filled with membranes contained no feces. In the ascending colon there were no mucous masses, but feces, with reddened mucosa. In the sigmoid the membranes could be torn from the reddened mucosa without loss of substance. Feces were found in the small intestine, which had reddened mucosa. The chief mucous masses were found in the left half of the transverse colon, descending colon and sigmoid. The microscope demonstrated the mucous masses in the lower colon to consist of mucin, not fibrin. In this case there can be no doubt of the existence of catarrh. Just on this point of catarrh or no catarrh, investigators are divided.

We have, then, three opinions in regard to the nature of secretion-neurosis of the colon, viz.:

(a) that it is an enteritis (catarrh),

(b) that is is simply excessive secretion of mucus (mucous colic),

(c) that it is a secretion-neurosis (nervous).

In general visceral neuroses we have, 1, motor neurosis (motus peristalticus); 2, sensory neuroses (hyperesthesia and anesthesia); and 3, secretory neuroses (excessive, deficient and disproportionate secretion). In secretion-neurosis of the colon we have to deal with a patient who has all three secretory disturbances, i. e:. deficient, disproportionate and excessive secretion. These patients have generally been long sufferers from constipation (deficient secretion). Then follows disproportion-secretion, but that is not so evident, as it simply produces fermentation. Finally, comes the formation of the habit of excessive secretion of mucus. Now, this excessive secretion of mucus arises from the unfortunate habit which the mucous cell had formed during the early but prolonged stage of constipation. The mucous cell had learned a bad, persistent, nervous or irritable habit of excessive secretion. After a long-continued bad habit of secreting excessive mucus, the cells were unable to change their mode of life and assume normal action. Hence, as one of the etiological factors of secretion-neurosis of the colon, we will assume the depraved cell habit, from reflex irritation.

A second factor that perhaps plays a chief role is genital disease. Secretion-neurosis of the colon is nearly always manifested in neurotic persons of the female sex. Such subjects nearly always have pelvic disease. Every gynecologist knows from actual experience, that pelvic disease produces constipation, a fore-runner of secretion-neurosis. Constipation may be secondary to genital disease, which through reflex action, produces in the bowel deficient, excessive or disproportionate secretion. Disproportionate secretion induces fermentation, causing gases which distend the bowel, resulting in atony and deranged nerve action in the epithelial

cell. Irritation from the diseased genitals induces the development of toxins. The toxins affect the tissues locally, inducing colitis, if not epithelial catarrh. Besides, the absorption of toxins induces neurasthenia. The diseased genitals reflexly lead to a train of conditions which induce defective nutrition and excretion. The evacuation of glassy, viscid mucus, subsequently followed by grayish shreds, extruded with pain, is pathognomonic of secretion-neurosis of the colon. Gynecologists frequently observe these conditions except the grayish shreds and muco-menbranous layers. The pain on defecation may be but slight.

The first step in the cure of such patients is to remove the afflicted genitals, when improvement often supervenes. In one of my patients suffering from chronic pelvic disease and also typical secretion-neurosis of the colon, many complex neurotic symptoms of an intense character would occasionally arise at the time of the evacuations. She presented paroxysms of pain, intense colic, profound hysterical or neurotic symptoms, rapid pulse, disturbed respiration; all of which subsided very slowly after the evacuation of mucus. Reflex neuroses of an intense character were present. In the intervals she was quiet, presented none of the acute egoism of the hysteric, and apparently had no desire for attention or notoriety.

The differentiation of the pathological process in secretion-neurosis of the colon may be aided by (a) the anatomic or pathologic findings in autopsies; (b) by analysis of clinical cases; (c) by examination of the evacuations; and (d) by comparison with analogous processes in other mucosa. We have spoken of the findings of the autopsy and in the evacuations; but too much cannot be said in regard to the correct clinical symptoms. The numerous names applied to the disease show that its clinical symptoms are not definitely agreed upon.

Colica flatulenta is a close relative of secretion-neurosis, as is also the motor neurosis (motus peristalticus) of the digestive tract. They consist of invisible derangements of the sympathetic nerve. Secretion-neurosis occurs in sub-

jects who can in almost all cases be demonstrated to be neurotics.

Comparison with similar processes in analogous structures may not clear up the pathology very much. In bronchitis crouposa chronica, a similar disease in a similar structure (mucosa), as in secretion-neurosis of the colon, there is no anatomical change in the bronchial mucosa, as noted by B. Littre, and there is no fibrin present. Klein, Neelson and Beschomer claim that the bronchial membrane and coagula in bronchial croup are thickened mucus or slime. That keen and able observer, Nothnagel, vigorously asserts as a comparison that the membranes of chronic croup speak against the fibrinous product and inflammatory nature of colica mucosa. However, conflicting opinions still exist in regard to the nature of the membranes in bronchial croup.

Do we receive any light in secretion-neurosis of the colon by comparing it with dysmenorrhea, which was first described by Morgagni in 1723 and colpitis membranacea by Farre in 1858? The number of terms applied to membranous dysmenorrhea, as endometritis exfoliativa, endometritis dessicans and decidua mesenteralis, signifies conflicting opinions. There are at least two irreconcilable opinions in regard to membranous dysmenorrhea, the inflammatory and the non-inflammatory conditions. It appears to the writer that a third view should be introduced, viz., that it is a *secretion-neurosis of the endometrium.*

However, it appears quite certain that there are two conditions classed as membranous dysmenorrhea, viz., in one case the membrane consists of fibrin, lymphoid cells and red blood corpuscles—a secretion-neurosis—and in another, the membrane consists of a cellular infiltrated endometrium—an inflammatory process. The second process throws off the endometrium with its blood-vessels, cell infiltration and utricular glands. Hence, under the general term, membranous dysmenorrhea, we are dealing with inflammatory processes (endometritis), and a secretion-neurosis (a fibro-lymphoid membrane enclosing accidentally red blood cor-

puscles, from diapedesis at the monthly congestion). The last process is a perverted nerve-action—a secretion-neurosis of the endometrium.

In an intensely lymphatic organ like the uterus we would expect more lymphoid elements in the membrane than in the colon. This would account for the fibrin and lymph cells. Also, red blood corpuscles are found in the evacuations of colica mucosa; and they are simply more numerous in the membrane of membranous dysmenorrhea, because of the intense endometric congestion, proceeding to rupture (diapedesis). Again, secretion-neurosis of the endometrium, like secretion-neurosis of the colon, evacuates the mucous membranes with or without pain, and at irregular intervals, showing a sustained comparison.

To say that the above diseases of the colon and uterus are forms of malnutrition or deranged innervation means but little.

In secretion-neurosis of the colon an explanation of the string and net-formed stools may be made from the contracted condition of the irritable muscle of the colon, which is thrown into folds, recesses and grooves, which allow the moulded form of the retained secreted mucus to persist. It may be mentioned that some confusion in diagnosis may arise by the so-called colica mucosa and enteritis co-existing. In other words a catarrh and secretion-neurosis of the colon may exist together.

The prognosis of secretion-neurosis of the colon, is, for life, favorable, but for recovery, doubtful. I have known the disease to continue for nine or ten years, with but slight changes. However, it is very variable in its attacks, and very erratic in its occurrence.

The treatment of secretion-neurosis of the colon must be directed to the nervous system, by habit, diet, physical and mental exercise, and general moral influences.

Regular daily bowel movements should be secured by very slight use of cathartics, considerable use of drinking fluids, and diet that leaves a large residue. Baths (medicated) twice weekly are very helpful. I have made some

patients happy and helpful to themselves, by urging them to return to their regular business, which had been stopped by other physicians. Clysters, and high rectal and colonic irrigations, aid wonderfully in evacuating the mucus. Intestinal antiseptics (Hg Cl 2), slight massage and long rests at night are beneficial. Much moral influence and helpful courage is given a patient, when he is told he will not die from the trouble; for thought concentrated on the disease makes him much worse—particularly because he is almost always a neurotic. Electricity aids physically and mentally. Sexual activity should be especially limited. Clothing should be carefully regulated to avoid sudden changes.

CONCLUSIONS.

1. These diseases should be termed secretion-neurosis or enteritis. The first is of neurotic origin and course.

2. Both secretion-neurosis and enteritis may co-exist.

3. Secretion-neurosis of the colon occurs chiefly in neurotic females.

4. It is closely associated with genital disease.

5. It is frequently preceded by constipation.

6. The continuation of the disease is partly due to an irritable, vicious habit of excessive epithelial activity.

7. The disease is characterized by colicky pains with the evacuation of mucous masses.

8. It is non-fatal, variable and erratic in attacks, with impossible prognosis as to time.

9. Microscopically, the evacuations appear as membranous, yellowish-white masses of mucus.

10. Microscopically, one sees hyaline bodies, cylindrical epithelium, cholesterin crystals, triple phosphates, round cells, various micro-organisms and pigment.

11. Chemically, the evacuations consist of mucin and albuminous substance.

12. Secretion-neurosis of the colon is comparable to the secretion-neurosis of the endometrium or bronchial croup.

13. Secretion-neurosis of the colon appears to be limited

chiefly to the part of the colon supplied by the inferior mesenteric ganglion, i. e., to the fecal reservoir.

14. It is a disease of the sympathetic secretory nerves, and is analogous to disease of the motor and sensory nerves of the viscera.

15. Its treatment consists of removing the neurosis, which lies in the foreground, and regulating the secretion, which lies in the background.

CONSTIPATION.

"Literature is the immortality of speech."—*Schlegel.*

Constipation is a neurosis of the fecal reservoir. It belongs essentially among the affections of sympathetic nerves.

The system of nerves (including Auerbach's and the Billroth-Meissner plexuses) which rules the gastro-intestinal tract is distinctly in the domain of the sympathetic. However, the physiological manifestations of the nerves ruling the small bowel are quite different from those ruling the large bowel. The nerves ruling the small intestine act with intense vigor and great rapidity. The nerves ruling the colon and rectum act with moderate force and very slowly. The small intestines rapidly force the contents to Bauhin's valve in a few hours. The nerves of the colon and rectum act slowly, evacuating the fecal reservoir usually once every twenty-four hours.

The change in physiological action from the vigorous, rapid motion of the small intestine, to the moderate, slow movement of the colon and rectum, must be due to the intervention of the inferior mesenteric ganglion, located at the root of the inferior mesenteric artery, which sends its radiating branches along the inferior mesenteric artery, supplying the left end of the transverse colon, the descending colon, the sigmoid flexture and the rectum. The ascending colon and the right half of the transverse colon are supplied by the abdominal brain, sending branches along the superior mesenteric artery. Now it is quite probable that the slow movement of the nerves belongs entirely to the

descending colon, sigmoid and rectum, which is entirely supplied by branches of the inferior mesenteric ganglia.

Hence, for the regular, periodic evacuation of feces, a habit established by ages, we must look to the immediate rhythmic control of the inferior mesenteric ganglion. This is in accord with the idea that the stool before expulsion lies in the sigmoid and rectal ampulla. That the portion of the bowel concerned in evacuation is under the control of a nervous mechanism, may be inferred from the fact that persons can establish almost any definite hour for regular defecation. A person can sometimes also restrain the stool without difficulty for several days.

For the cause of constipation we must look to a peculiar nervous disturbance in the peristalsis of the colon, or of that part of the bowel supplied by the branches of the inferior mesenteric ganglion.

In constipation the feces are found in the colon and not in the small intestine. This abnormality of the colonic innervation may be congenital or acquired. Some individuals are constipated from childhood. A boy of fifteen came to my office a short time ago, who had never had a stool from babyhood onward, without a rectal injection or some heavy physic. By careful examination it appeared that neither the cerebro-spinal nor the sympathetic system was fully or completely developed. However, in a month, from physical procedures, massage, rectal injections, vigorous riding and regular stool hours, we secured a habit of daily evacuation. Here, doubtless the trouble was congenital—deficient and imperfect development.

Depressing mental affections derange the regular bowel action. However, in constipation accompanying melancholia or mental disturbances, it seems to me that it is impossible at present to decide which is the cause and which the effect. To illustrate the influence of the nervous system over bowel evacuation, observe how a railroad journey, a change of locality, festivals and change of labor, affect a constipated condition. Besides, autopsies of persons dead from other diseases, teach that in constipation seldom can structural lesions be demonstrated.

The chief features of habitual constipation tend to show that the abnormal condition must be sought in a neurosis of the colon (including the sigmoid and rectum). The exact nature of the colonic affection is unknown. Another factor in constipation is that though the nervous system of the colon be fairly developed, yet the muscle of the bowel is not normally developed. There is atony of the bowel wall, well expressed by the old Latin authors as "atonia intestini." But in this case perhaps the bowel muscular atrophy goes back to the nerves, as they control the lumen of the blood-vessel, which is the real nourisher.

In regard to the relations of the skeletal muscles to the bowel muscles, in constipation, we maintain that they are entirely independent of each other. The subject with the most weakened and miserable condition of the skeletal muscles may be absolutely regular in bowel evacuation, or may suffer severe constipation. Of course we must not omit the mechanical influence of the abdominal muscles in defecation. The abdominal muscles increase the intra-abdominal pressure, and thus aid evacuation, but it is not likely that they increase peristalsis. Perhaps in general the skeletal or bowel muscles play but a small role in constipation. The matter lies closer to the nervous system.

Bouveret and Dunin have claimed that habitual constipation was a frequent accompaniment of general nervousness, especially of neurasthenia; that the neurosis was the cause of the constipation and not the constipation the cause of the neurosis. This idea is apt to prevail with most force among those physicians who, in curing the patient of the general neurosis, neurasthenia, have seen the constipation disappear. Fleiner asserts that stool retardation is due to spasmodic contraction of bowel segments, holding fast their contents. This would make the trouble depend on the nervous system.

The mechanical conditions that induce constipation will not be here considered, except so far as their purely nervous mechanism and influence is concerned. Hence, such factors as strangulation by peritonitic bands and through

apertures, the mechanical difficulties of enteroptosis and pressure of abdominal tumors, are not here discussed.

However, we must not overlook the obstacles placed in the way of the bowel nerves by inflammation of any one of the bowel coats or tunics, as peritonitis, or inflammation of the muscularis or of the mucosa. As abdominal surgeons we well know that acute peritonitis produces immediate constipation, checking peristalsis by oedema, congestion and exudation into one of the bowel tunics, especially the peritoneum. The peripheral bowel nerve apparatus is deranged by pressure, infection and malnutrition. It may rapidly recover. But doubtless a crippled and defective condition frequently remains—non-mechanical. As a result of peritonitis or inflammation of any one of the bowel tunics, producing habitual constipation, we must especially examine the *flexura coli lienalis* and the *flexura sigmoidea*. Not infrequently the action of the lower left end of the diaphragmatic muscles produces inflammation of the descending colon, by inducing emigration of microbes by muscular trauma. Also, the conditions disturbing the rectal nerves must be considered as causing congestion and its results. In constipation we only include the bowel segment supplied by the branches of the inferior mesenteric ganglion. It must not be supposed for one moment that peritonitis around the evacuating fecal depository is always recognized. Far from it, for in some 350 adult autopsies I found evidences of peritonitis in the peritoneum of the descending colon in fully eighty per cent of subjects. In fact, in the meso-sigmoid alone, there was about seventy-five per cent of peritonitis.

Constipation may arise in some persons from deficient or abnormally small abdominal brain, or from premature senility in the abdominal sympathetic, which innervates the gastro-intestinal tract; also from cerebro-spinal disease, which cuts off sources of energy. Exhaustion, mental or physical, is a potent factor in constipation. A deficient blood supply to the parenchymal ganglion does not invigorate it sufficiently to induce peristalsis. Exhaustion

from over-exertion, excessive sexual action, or extra loss of blood, is a common cause of constipation in young women. Depression from disappointment, from death, from unrequited love and many other causes is quite apparent in the youthful in producing constipation—a purely nervous phenomenon.

Constipation in lead-colic is a nervous phenomenon, apparent in the intestinal pain, and in the white ring-like contraction of the circular bowel fibers. The etiological factor is the irritation of the parenchymal ganglia of the bowel wall by the lead. Spasm, irregularity or inertia characterizes the bowels in lead-colic. However, it differs in no particular respect from other forms of colic, except in the etiology.

Violent and persistent constipation depends on perverted muscular action, sensation or secretion, due in general to some deficiency of nerve force. Bowel inertia may rest on deficient blood supply to the parenchymal ganglia, but this is directly under the control of the sympathetic, which holds sway over the vessels' caliber. It must always be borne in mind that the size of the sympathetic differs very much in different individuals. When a small sized visceral nervous system becomes impaired, as it easily will, its phenomena are not only marked but difficult to correct. A large dose of digitalis slows the heart, and whether the spinal accessory or vagus rules the heart, digitalis inhibits its action. Nothnagel suggests that opium works similarly on the splanchnics, i. e., by slowing peristalsis. The movements of the intestines are largely dependent on the amount of blood in the intestinal wall, i. e., the amount of fresh blood which supplies the parenchymal ganglia.

In regard to antiperistalsis, in scores of experiments on dogs, rabbits, guinea-pigs, etc., I never saw such a phenomenon. The vomiting in ileus paralyticus or peritonitis may be due to simple contraction of the stomach on the enclosed contents, when the fluids pass through the œsophagus in the direction of least resistance. The monstrously large, wide cecum of herbivora, a vestigial stomach, as in the cow and horse, is emptied by peristalsis and

not by antiperistalsis, as noted by Jreper. It may be that the peristalsis is increased in diarrhea, yet it may be just as active in constipation, but in this the bowel movements are vain and futile, from inability to force the contents into successive new segments, for an empty bowel is a still one and a full bowel is an active one. Also, active peristalsis will invite more blood into the bowel wall, which in turn induces active motion in the segments. Doubtless herein lies the value of abdominal massage. Whatever checks the flow of fresh blood to the bowel wall slows peristalsis, and this explains the constipation of anemia.

The natural secretions, as the bile and the pancreatic fluids, are perhaps sufficient alone to stir up the parenchymal ganglia to action, with but little or no aid from the splanchnics. Hence, with inactive hepatic secretion constipation may result. Consequent swelling of the mucosa from catarrh, in the bile ducts, may exclude the bile from other channels which would deprive the parenchymal ganglia of their accustomed stimulus.

The relations of adjacent viscera and their condition may influence constipation. If the accustomed secretions, bile, pancreatic and gastro-intestinal, lessen the bowel will not receive the impulse which the normal amount of secretions impart, and peristalsis partially fails. Diarrhea may be set up by congestion, then by œdema, and instead of infiltrating the bowel wall, the result may be a rapid exudation and diarrhea.

Increased peristalsis, however, is not necessarily accompanied by increased secretion and exudation. The irritation which produces the peristalsis may so irritate the parietal intestinal ganglia as to lessen the caliber of the blood-vessels and thus check secretion. In administering certain purgatives it is found that they are followed by watery evacuations. But this may be due to exalted peristalsis of the bowel, allowing insufficient time for absorption, e. g., in times of quiet peace in the bowel, secretion and absorption balance each other; but if segments of the bowel become irritated by cathartics, the secretions may become very much increased. Yet owing to the vigorous peristal-

sis the fluids are rushed onward, not allowing sufficient time for absorption.

Constipation is generally a form of neurosis, which may partake of a sensory, motor or secretory nature. It may, however, have a complex course and origin. Constipation is a condition in which the bowels are not evacuated daily, except by the aid of evacuants, rectal injections or physical procedures. The great majority of the human family having a daily bowel evacuation, establishes the normal frequency at once a day. Exceptions to this general rule may be observed, in certain individuals who have two stools daily, others one stool in two or three days, while again Pick reports patients who have one stool a week. A doubtful report was made by Dr. Robert Williams, where a woman had four bowel movements in a year, three months apart

This irregularity or deviation from normal defecation, need not necessarily be based upon demonstrable pathological conditions. In constipation we have several elements to consider, the mucosa, the muscularis, the bloodvessels, the serosa and the nerve-supply.

Perhaps the greatest etiological factor of constipation is enteritis, catarrh of the bowel mucosa. This would involve the secretory nerves. In fact catarrhal diseases of the bowel mucosa are the active factors in the ever changing forms of constipation and diarrhea, which doubtless involve the secretory nerves more than the motor nerves. Of course the regularity of stool depends very much on the kind of food eaten, for if the food leaves no residue it will conduce to constipation, for the greatest of all stimuli to bowel motion is food in contact with the intestinal mucosa. The peripheral nerves of the intestinal mucosa receive impetus and sensation from the analward moving fecal remnants.

The chief influence in constipation is the food. The formation of the stool depends mainly on the relation of the solids and fluids introduced into the stomach. A close relation exists in constipation between the quantity of food taken into the stomach and the resulting residue, which

actively counts in treatment. Water is one of the best adjunct evacuants. An exclusively milk diet may create constipation, because the small residue is insufficient to excite peristalsis through the peripheral nerves. If milk creates diarrhea, it is likely from some sudden development of germs or fermentation. The utility of graham bread in curing constipation lies in the fact that a large indigestible residue remains, inducing bowel contraction; its contained salts either invite fluids or excite peristalsis, both resulting in a kind of massage or acting like a foreign body to the mucosa.

The habits of life have much to do with constipation. Society women and traveling men, with irregular living and habits, are liable to constipation. Sedentary habits, deficient exercise and excessive mental work, tend to produce constipation. The use of narcotics, deficient drinking of water, active perspiration and uncomfortable closets, play a role in inducing constipation. Over-eating or overloading the gastro-intestinal canal may lead to atony of the bowel wall and consequent constipation. The causal relations of constipation must be sought in the digestive tract itself,in the kind of food taken, in the habits, in the relations of other viscera.

In certain cerebro-spinal diseases, the sensory nerves of the bowel mucosa may be obtunded or blunted, so that the ordinary peristalsis is not excited by the ordinary stimulus of food residue. The peripheral sensory apparatus of the mucosa does not perceive the usual stimulus and the bowels become torpid. This is common in certain forms of hysteria, or better, visceral neurosis. In melancholics and hypochondriacs the barometer of their spirits seems often to tally exactly with the bowel activity. The greater the activity of their bowels, the more lively and natural their mentality. But it must not be forgotten that constipation is often occasioned by the mental condition. We know personally that vomiting may be called up by a physical cause or by a mental one. Some will vomit from seeing a fly in the soup. So it is with a general neurosis, it may create constipation, or may induce a local neurosis by bathing the in-

numerable ganglia with waste-laden blood. If secretion be deficient, absorption continues, the feces harden, form an increasing plug, and become such an impediment that even vigorous peristalsis will not produce the analward movement required.

Heredity and congenital ailments play a role through the defects in the nerves of the intestines. We deal here chiefly with the purely nervous influence, as the bowels of the cachectic may be confined, or may act very irregularly. Persons with defective nervous systems, as idiots and the insane, suffer from constipation. The ill-defined hysteric person, or the neurotic subject, is painfully afflicted with constipation, with sluggish bowels, and some of these very subjects are continually complaining of colicky pains, which are to be interpreted as vain attempts of peristalsis to force the bowel contents analward.

In constipation enteroptosis plays its role by kinking the bowel, producing conditions which require more vigorous peristalsis to overcome; in short, by conpromising the bowel caliber. In enteroptosis the hepatic and splenic flexures are both made more acute by the consequent dragging of the *ligamentum hepatico-colicum et phrenico-colicum sinistrum.*

The fecal reservoir, as previously stated, is the left half of the transverse colon, the descending colon, the sigmoid and rectum, the field ruled by the inferior mesenteric ganglion. It has been asserted by my old teacher, Nothnagel, that constipation is relatively frequent in comparison with the rarity of peritoneal fixation. I wish respectfully to differ from this excellent and instructive Viennese teacher. In some five hundred personal autopsies I found peritonitis in the fecal reservoir in at least 80 per cent of subjects. This peritonitis is due to two causes, viz., traumatic muscular action of the psoas magnus on the sigmoid, and of the lower left limb of the diaphragm on the descending colon, which induces emigration of pathogenic microbes to the serosa; and the abrading of the mucosa of the fecal reservoir at the flexures (splenic and sigmoid), allowing the wound to become infected and the migration of pathogenic

germs to the serosa. Nowhere in the body is infection from mucal abrasion more definite than at the *ligamentum phrenico-colicum sinistrum.* In these adult autopsies we find that the fecal reservoir was afflicted with peritonitis in more than eighty per cent of the cases. Did eighty per cent of these cases suffer from constipation? We think not. Therefore, according to our five hundred autopsies, peritonitis of the fecal reservoir is far more common than constipation, for eighty per cent of adults do not suffer from constipation. Hence, we are forced to the opinion that peritonitis of the fecal reservoir has undoubtedly an influence in inducing constipation, by crippling the nerves presiding over defecation. The nerves may suffer from pressure by exudates or œdema, from congestion or malnutrition. The final outcome is derangement of the nerves of the fecal reservoir—exaltation or debasement of sensation and motion. As probability is the rule of life, the results of peritonitis of the fecal reservoir should be a lowering of sensibility and motion of said nerves, consequently, constipation. Chronic peritonitis of the fecal reservoir is here referred to, and not acute peritonitis. I have shown (Peritoneal Adhesions after Laparotomy, Amer. Gyn. & Obstet. Jour., Dec., 1895) that gross peritoneal adhesions (bands) attached to organs of high peristaltic action, as the middle of the sigmoid, the Fallopian tubes (or their amputated ends), the mobile bladder, or the active peristaltic loop of small intestine, frequently create very much pain, though not necessarily constipation. Yet the finer pathological infiltrations, perhaps not even macroscopic, or at least too slightly to create conditions of the fecal reservoir which may be far more effective in causing constipation than the gross peritoneal bands which simply fix viscera or parts of viscera, are an important factor in inducing constipation in enteroptosis. Perhaps enteroptosis should be viewed as a constitutional disease, a general neurosis. The visceral supports very gradually elongate in enteroptosis, and the nerves as gradually lose their tone. That the visceral nerves are involved in enteroptosis is very evident from the manifest derangement of the nerves of sensa-

tion, motion and secretion. Enteroptosis is a weakening of the nervous system, a special slackening or elongation of the visceral supports, which we must acknowledge is not manifest in the digestive tract muscles, but attacks the skeletal muscles (e. g., of the abdominal wall).

Every practitioner has observed that with the induction of habitual constipation a peculiar nervous phenomenon also arises. The popular opinion is that the constipation is the cause of the neurosis, but such an opinion does not always stand the test of analysis. Is the neurosis not the cause of the constipation? The finer beginning of the neurosis was not observed, while the grossness of constipation is discernible from beginning to end. After constipation has once started, a train of symptoms may set in, as long retention of the feces allows them to become dry and hard from absorption of fluids. The feces become pressed into the saccules of the colon as hard, irregular masses, known as scybala. Such masses by continued pressure may produce mucous ulceration. The subject experiences fullness in the abdomen and disagreeable sensations; the appetite disappears, gases are eructed and a disagreeable taste arises in the mouth. The skin may assume a muddy color and the fecal masses may be covered with mucus in various quantities. Some practitioners falsely attribute the slime or mucus to colonic catarrh. The excessive mucus in due to irritation of the mucosa by the fecal masses, which irritation may also call up a hyperemia of the mucosa, producing disordered secretion, with fermentation and gases. The fecal accumulation can produce not only a transitory mucal hyperemia, excessive secretion and diarrhea, but anatomic changes, such as colonic catarrh, trauma of the colonic wall and local peritonitis. Considerable colic may arise from the attempts of the bowel to expel the large accumulated masses, which palpation may reveal.

But to speak of the difficulties arising from hardened masses of accumulated feces, is only to bring in mechanical difficulties, with all their train of evils on the three tunics of the bowels and their functions, which is not our chief

theme. Our contention is that constipation is a neurosis of the fecal reservoir.

To illustrate how intimately the nervous system rules the fecal reservoir in its periodic evacuations, all that is necessary is to recall how many patients relate that, on change of business, residence or scenery, the evacuations being neglected, cease their regularity. So far as I am aware, constipation always has as one of its results, the collection of feces in the colon, from the rectal ampulla to Bauhin's valve, but the chief locality is from the middle of the transverse colon to the rectal ampulla. The collection of fecal masses in the ascending colon is rare, and perhaps in the right half of the colon it is also rare, except from mechanical causes, i. e., if half the colon be full of hardened feces, the right half will be full, from the physical fact of its inability to force them onward.

The train of evils brought on by constipation is almost endless, e. g., the fecal masses produce pressure on the returning veins of the fecal reservoir, causing congestion, especially in the rectal veins, resulting in hemorrhoids. Perier has recently attempted to show that the so-called "fecal fever" is due to absorption from the digestive tract. The proof of this he demonstrates by a cathartic reducing the fever. This view of Perier has some show of truth in it, for in puerperal sepsis, in fever after operation, a cathartic reduces the fever like a charm. The drain by the cathartic directs the poison outward. However, it must be remembered that high temperature subsequent to some pelvic operations is rather due to absorption of septic matter remaining in the pelvis than to absorption from the bowel. For long past and even to-day there exist certain wide-spread opinions, in regard to certain definite connections between the central nervous system and constipation. Constipation and the central nervous system are brought into close relations. All grades of symptoms, from the slightest disturbance up to hypochondrical and severe psychical, are included as due to constipation. Certain writers have tried to show that relations exist between dyspepsia and constipation on the one hand, and hypochondria and

melancholia on the other. Virchow started such views nearly fifty years ago, and Virchow always writes with a pencil of light. The celebrated neurologist, Romberg, claimed in 1850, that constipation could induce hypochondria. It is not strange that the opinions of such giants as Virchow and Romberg, both strengthened by observations, should prevail so long. But our belief is that constipation is a neurosis of the fecal reservoir. Hence, constipation, melancholia and hypochondria, are the result of the neurosis and not the cause. We must look to neurasthenia as the forerunner of constipation, as the neurotic invader of the fecal reservoir, bringing in its wake constipation. When neurasthenia and melancholia enter, the process becomes retarded. Recently Dunin has favored the view that constipation is the result of a neurosis and not the cause. True it is that nervous persons do not always suffer from constipation, nor are non-nervous persons invariably free from it, but first be it remembered that the fecal reservoir is chiefly under the influence of the inferior mesenteric ganglion and its radiating nerves (sympathetic), and not the cerebro-spinal, though the last-named exercises certain influences over the fecal reservoir; also that the fecal neurosis is a local affair, i. e., the peripheral nerves supplying the large bowel in the area of the inferior mesenteric artery may be attacked by disease, independently of the remaining sympathetic and cerebro-spinal systems.

The general view entertained in regard to constipation and neurosis is, that the constipation is the cause of nervous symptoms, e. g., a person suffers for several days from constipation and light cerebral symptoms arise, as headache, dizziness, pressure in the head and inability to think well. There may be feelings of heat in the head and considerable general languor. The urine may be a little scanty and high-colored, with hot and dry skin. There is often slight respiratory disturbance. Physicians generally attempt to prove that all these cerebral symptoms depend on the several days of constipation, from the fact that after a brisk cathartic all the cerebral symptoms disappear. This circle may be and often is repeated in the same individual.

At first sight this explanation with its practical demonstration seems very laudable. But is it satisfactory? Cannot the neurosis, the subjective light cerebral symptoms, be the cause of the constipation? It is not easy to give a categorical proof of this. The disturbance or hindrance in respiration and circulation may find an explanation in the elevation of the diaphragm. The cerebral circulation may be disturbed by the reflex irritation of the abdominal viscera, transmitting the irritation by way of the lateral chain of the sympathetic and the splanchnics. Leube has recently reported cases where the person became dizzy from pressure in the rectum, either by fecal masses or by the finger. Here the dizziness arises from irritation of the hemorrhoidal plexus of nerves.

Again, Senator suggests that the absorption of certain gases, as sulphuretted hydrogen, might induce poisonous symptoms. Nothnagel suggests that in constipation ptomaines might be absorbed, inducing cerebral symptoms. But Bouchard demonstrated that toxic fecal ptomaines mainly occur in fluid feces, as is seen in the large amount found in the urine of patients afflicted with diarrhea. Again, the cerebral symptoms accompanying constipation may be due to the absorption of aromatic substances, as noted by Nothnagel. The general view of the profession is that the cerebral symptoms depend on the constipation. Is the argument the same with melancholia and hypochondria? Does it depend on constipation? In other words, does constipation cause, in otherwise healthy persons, hypochondria or other psychoses? We think it does not. The proposition should be made in two forms:

(a) Constipation may occur in otherwise healthy persons. These we claim do not suffer the hypochondria and psychoses.

(b) Constipation occurs in patients with a neurotic tendency. These last are the subjects which suffer from melancholic psychoses during constipation. It is undeniable that psychical depression may develop during constipation in certain persons, but they are of the neurotic type, and in these the abdominal disturbance in the bowels would

similarly affect (as disturbances in any other functions) the weakest point, i. e., the part of the animal economy which resists the least. Single-handed and alone constipation does not create hypochondria and melancholia, but in a system burdened with neurotic tendencies, with unstable nerves, they may exist, but are perhaps the cause of the constipation.

Virchow says the following: "*das bei einer gewissen erregungs fahigkeit widerstands losigkeit*, (predisposition) *des Nerven apparatus storhungen in den Unterleibsorganen Erscheinungen mit dem Character der exaltation an den Sensitiven und dem der Depression an den Motorichen Nerven herrufen.*" Freely translated it is, "that by certain tendencies (non-resistance, predisposition) of the nervous apparatus disturbances of the abdominal viscera may produce the character of exaltation in the sensitive nerves and depression in the motor nerves." It appears to me, however, that the popular professional opinion of the effect of constipation on the brain is exaggerated, and much of the belief untenable.

The celebrated English author and physician, Dr. Barnes, held that constipation is the cause of chlorosis. Perhaps this view arises from the supposed fact that some of the chlorotic girls recovered after cathartic treatment. But since chlorosis is a disease of a certain age, i. e., from 15 to 25 years of age, such a fact remains yet to be proved. For the constipation accompanying chlorosis constitutes but a small portion of the ailments of those attacked by it. Constipation and neurosis are, nevertheless, close relatives in many subjects with peculiar nervous symptoms.

The relation of the gastro-intestinal canal to other viscera is of prime importance as modifying peristalsis. The emphysematous lungs force the diaphragm downward and this destroys the tendency to free peristalsis. Heart, liver and kidney diseases, if they produce congestion in the bowel coats, serosa, muscularis or mucosa, will lessen peristalsis and consequent fecal motion. Diabetes induces constipation by diverting fluids from the bowels and the consequent drying of the feces. In the chlorotic and anemic it is diffi-

course. In the case of an anal fissure the irritation is purely reflex on the remaining portion of the gastro-intestinal canal. It would appear that constipation, in certain forms, may be well remedied by daily dilatation of the sphincter. Dr. Beer reports successes in the *Wiener med. Blatter*, 1891, No. 25.

The complex symptoms of constipation may be indecisively divided into general and local symptoms. The general and most disastrous symptom is that of auto-intoxication. It represents a whole series of manifestations in the territory of the nervous system, whether it be chronic or acute, common symptoms or head-ache, dizziness and neuralgias about the abdomen, as well as sleepiness, melancholia, languor, a feeling of debility and nausea. Pick says the visible expression of the constipation is the richness of excretory principles in the urine and the increased toxicity of the same.

One of the local symptoms of constipation is the feeling of fullness and pressure in the abdomen, which is generally distended. The passage of gas gives temporary relief. The diaphragm is forced upwards, compromising the heart, so that it not infrequently palpitates, and the lung manifests difficulty in respiration. In certain cases considerable colic is produced at stool, from irritation of the bowel wall by the hard fecal masses. The locations of local colic from expelling hardened feces are the ampulla of the rectum, the cecum, the hepatic and splenic flexures, the middle of the transverse colon, and S-romanum. Large hard, rough fecal masses not only cause much pain but they abrade the mucosa and finally produce ulcerations, which heal but slowly.

The diagnosis of constipation is a very small factor in practice, but the finest head with the utmost skill is required to diagnose the etiology, for on the cause of this malady rests the successful treatment. It is needless to say that a thorough and complete physical examination is absolutely necessary. For constipation may depend on the kind of food taken, on habits of life, on drugs employed or on defects in the system. Some affirm that heredity plays a role in constipation; however, this is only a cloak to cover

up what we do not know. Many persons who have only one stool in two days, and remain healthy, are not constipated and require no treatment.

First, in the treatment of constipation, should be considered the diet. Some physicians have a diet list. In certain cases it is convenient, but generally of little value. Oatmeal and graham bread, with milk as a beverage, leaves ample residue to induce peristalsis, which soon overcomes constipation. In such cases, also, a few daily colonic flushings aid wonderfully, with the establishment of a regular hour for evacuation. Especial stress should be laid on the matter of avoiding cathartics; they are among the chief causes of constipation. The best methods of curing constipation are those which imitate nature the closest and most perfectly. They are, in order:

1. The regulation of diet.
2. Physical procedures.
3. The judicious use of cathartics.

In the regulation of the diet several factors are requisite, viz.: food which leaves a large residue, which will impart the necessary constant stimulus to successive bowel segments. Peristalsis requires a physical stimulus, a bolus that will feel its way from stomach to anus. The diet should be a mixed one of cereals, meats, and fruits, as well as concentrated foods. It should be eaten at regular, fixed hours. The bowel is an organ wonderfully inclined to drop into stubborn habits. Subjects who eat at any and all hours are apt to become just as irregular in evacuations. To show the effect of habit, observe how much more women are constipated than men—a result of insufficient physical exercise or sedentary life. Also, ample fluid should be taken with the foods

The good effect of graham bread is chiefly due to the large residue and the contained salts—both acting physically on the bowel causing peristalsis. The habits of the use of narcotics, drinking, smoking, chewing and taking of morphine, sexual abuses, over mental activity, etc., should be modified.

The second method of treatment in constipation is the use

of some physical procedure. Of these several are important. Among the first is the establishment of regular habits of evacuation and overcoming irregular ones. The bowels should be evacuated every morning after breakfast, i. e., after drinking hot fluid and eating hot food. Heat starts peristalsis. The mental state has much influence over the bowels, so that if the mind is set on a distinct hour for an evacuation, it is pretty sure to be secured. Another valuable factor is regular and vigorous daily exercise. The most natural are walking, horseback and bicycle riding. The habit of exercise is nearly always sufficient to overcome constipation. Gymnastics serve a similar object.

When the above exercises are not carried out, one of the sovereign cures of constipation is massage; at first, weak or light rubbing should be employed once or twice daily; subsequently, vigorous massage should be carried on. Stroking rubbing, tapping, kneading and gripping the abdominal wall should be judiciously performed. The large intestine should be massaged from cecum to rectum, following the line of the colon and the direction of the fecal current. Rolling a bag of shot or dry sand over the abdomen is effective if continued many days. Much patience on the part of both patient and physician will be required to continue the massage, for it may need a month to accomplish permanent results by this process. Rolling on the abdomen for ten to fifteen minutes every morning accomplishes good results in constipation. Another excellent remedy for both its mental and its physical effects is electricity. Either the galvanic or the faradic current is effective. The muscle walls of the abdomen can not only be treated by the electricity, but one of the electrodes may be inserted into the rectum.

Another physical procedure of great value in constipation is irrigation by colonic flushings or rectal injections. For mild cases a rectal injection of one-half a pint of plain water is sufficient to irritate the bowel and excite an evacuation. In more stubborn cases a quart of water may be injected, by a fountain syringe, held two feet above the patient and allowing the fluid to flow into the bowel. Another method is to turn a chair upside down, place a quilt over it,

and then place the patient over this inclined plane, with the hips well elevated and shoulders well down. Then allow a quart of water to gradually pass into the colon.

Besides the water injections, one may employ stimulants, such as epsom salts, olive oil, glycerin and water at different temperatures. The irrigation is accomplished with more safety and efficiency with the fountain syringe at a low level, e. g., about two feet above the patient's hips. Cold fluid injections excite the bowels; however, warm fluids dissolve feces more rapidly. To dissolve and soften fecal masses, warm olive oil is excellent. Hence, to produce an immediate stool, a cold water rectal injection of one-half a pint will be the most effective, as it at once induces active peristalsis. This may be aided by rolling a bag of sand or shot over the abdomen. Daily dilatation of the rectum, especially when it is inclined to spasm or is subject to fissure, ulceration or hemorrhoids, is a useful procedure.

Finally, in the treatment of constipation we come to the use of drugs—at once the most disastrous and inefficient of all methods. Cathartics are to be avoided as much as possible in constipation. Constipation is generally the result of catarrh. Cathartics influence catarrh injuriously by further complicating the circulation and inducing congestions and depletions. In the treatment of diseases peculiar to women which I have diligently followed for fifteen years, and where constipation is a common matter, I seldom advise a cathartic, pure and simple. The method I have followed successfully in scores of cases is to have the patient drink a large glass of water, in which is placed one-half a dram of magnesium sulphate, every night on retiring, and to go to stool every morning immediately after breakfast, e. g., after drinking hot coffee, which stimulates peristalsis.

The method is generally successful, but can be made more efficient by inducing the patient to drink a glass of hot water in which is dropped ten drops of tincture of nux vomica, every morning before breakfast. I think a vigorous salt bath, twice weekly, improves constipated patients by the reflex irritation. As a simple drug-method for constipation, a small pill of aloes, strychnine and belladonna is

quite efficient. It does not physic, but stimulates sufficiently to induce an evacuation. Drastic cathartics are the friends of constipation. The number of cathartics is very great. The choice of one will depend on whether the drug is intended for short or long use. If a cathartic be employed for a short use, to secure an immediate evacuation, one of vigorous nature should be selected. For this purpose none are superior to calomel followed by magnesium sulphate. The calomel stimulates the whole gastro-intestinal glandular apparatus, while the salts induce a large flow of fluids into the bowel. I have used these cathartics thousands of times and have not yet observed superior ones. The violent drastic cathartics, such as croton oil, podophyllin, colocynth and elaterium are seldom required.

Should a carthartic be required for prolonged use, one of a mild nature should be selected, such as rhubarb, magnesium sulphate, senna, aloes and cascara sagrada. Drugs administered for chronic constipation should be employed at night, so that the quietude of the patient will allow the drug to pass slowly over the whole mucosa. I am of the opinion that the addition of belladonna to cathartic pills is superfluous, and therapeutically only adds injury to insult. The cathartic insults the mucosa, while the belladonna injures it by attempting to deceive it by anesthesia—both enemies to the normal, peaceful, mucosa life

The beneficial effects of mineral waters, which generally depend upon the contained glauber and epsom salts, are only secured by long-continued use. Of the two forms of drugs, pills or liquids, given for constipation, the pill form is the superior one, because it works slowly and thus imitates nature more closely. Nature always resents violent insults with evil consequences. Nature itself is a bundle of habits, and if we are to be successful we must imitate her methods. Hence, we must employ for constipation, diet, exercise, physical procedure and, lastly, adjuvant cathartics—we must study the sympathetic nervous system.

The treatment of constipation does not consist in searching after and administering cathartics, but rather in the avoidance of their use. We may first say that constipation

is not curable by any planless method, nor by any planned method imperfectly executed, while there may really be non-removable anatomical conditions causing the difficulty. Planless prescribing of cathartics is worse than useless. The head and point of all therapeutics in constipation consists in discovering the cause. Is the habitual constipation due to an original, abnormal, nervous suspension of the peristalsis of the fecal reservoir? This concerns us and our therapeutics; though we may find difficulty in excluding congenital defects, such as atony of the bowel-wall, or constipation due to dislocated viscera. Is the constipation, as Dunin suggests, a mere symptom of neurasthenia? If our original proposition be true, viz.: that constipation is a neurosis of the fecal reservoir, cathartics are not only useless, but harmful

In constipation we should attempt to cure the neurosis, the neurasthenia, when the constipation will disappear. The moral past of the patient should receive attention, for often there is far more in the suggestions added to medicines, than the remedies themselves can supply. If the constipation depends on suspension of peristalsis, either from muscular atony or from deficient innervation, it is plain how mal-practice resides in the use of cathartics. Physical procedures must, above all, be employed in muscular atony or defective innervation of the fecal reservoir.

CONCLUSIONS.

1. Constipation is a neurosis of the fecal reservoir.

2. The fecal reservoir consists of the left half of the transverse colon, descending colon, sigmoid and rectum.

3. The fecal reservoir is under the influence of the inferior mesenteric ganglion, which sends its radiating branches along the inferior mesenteric artery.

4. The difference between the rapid and vigorous peristalsis from the presence of contents of the bowel, supplied by the abdominal brain and its branches, conducted on the superior mesenteric artery, and the slow, moderate peristalsis and periodic evacuation of the fecal reservoir supplied by the inferior mesenteric ganglion, with its branches loca-

ted on the inferior mesenteric artery, is due to the intervention of the inferior mesenteric ganglion.

5. The superior mesenteric ganglion, presiding over the small intestine and the right half of the large bowel, perhaps evacuates or forwards its contents analward, three to five times daily, while the inferior mesenteric ganglion, presiding over the fecal reservoir, evacuates or forwards its contents analward once daily.

6. The difference in function between the superior and inferior mesenteric ganglia (a matter of time, or rapid and slow peristaltic action), is in all probability a process of evolutionary acquisition; the evacuation of the fecal reservoir being governed by physical facts of necessity and comfort.

7. Constipation produces slight cerebral symptoms, such as headache, dizziness, a feeling of pressure in the head, inability to think well, etc. However, the disturbed circulation and respiration may be explained by physical facts, such as the elevation of the diaphragm, and pressure.

8. The demonstration that slight cerebral symptoms are caused by constipation, is due to the general observation, that the symptoms disappear with the action of a cathartic.

9. Constipation occurs in otherwise healthy persons, and especially in persons with a neurotic tendency.

10. It may be assumed that melancholia, hypochondria and certain neuroses, are the forerunners, the causes, of constipation.

11. In certain persons of unstable nerve equilibrium, feeble, non-resistant, predisposed to disturbance in the nervous apparatus, or to disturbance in the abdominal viscera, symptoms occur having the character of exaltation of the sensory and depression of the motor nerves.

12. In these conclusions mechanical obstructions are considered only as they belong to the nervous system.

13. Enteroptosis is begun and maintained as a neurosis, chiefly of the sympathetic nerves.

14. It is doubtful whether catarrh is a cause of constipation, for peristalsis is generally more active in catarrh than in the normal condition.

15. Cathartics are the best friends to constipation, as they tend to establish irregular habits in the evacuation of the fecal reservoir. Cathartics are enemies to regular normal bowel evacuation.

16. The treatment of constipation is both mental and physical.

17. The first treatment consists in establishing, mentally and physically, regular hours of evacuating the fecal reservoir

18. The second treatment should consist in the regulation of diet. Abundance of fluids should be drunk. The food administered should leave an ample residue, sufficient to produce peristalsis. It should be mixed food. A full bowel is an active one. An empty bowel is a quiet one.

19. The third treatment consists in aids by physical procedures, as exercise, gymnastics, massage, electricity, rectal injections and hydrotherapy. Friction on the abdominal skin, from baths, etc., is effective in a reflex manner; certain areas of skin on the abdomen being indirectly connected with the function of the viscera. (See "Brain" by Head, 1893.)

20. A fourth treatment of constipation consists in the judicious use of various mild cathartics.

21. Among drugs I have had the most benefits from the following: Order a glass of water every night on retiring, and add to it a half to a teaspoonful of epsom salts. Insist on a regular evacuation of the fecal reservoir after breakfast, as soon as the hot coffee and food has stirred up peristalsis. An additional very useful method is to have the patient drink half a glass of hot water with ten drops of tincture of nux vomica in it before each meal.

22. Constipation is more effectually cured at home, for if a patient makes regular trips to health-resorts to cure his constipation, he will neglect his moral and physical resources at home, where his life is spent.

CHAPTER XII.

SUDDEN ACUTE ABDOMINAL PAIN: ITS SIGNIFICANCE.

"Nature has her own best mode of doing each thing, and she has somewhere told it plainly, if we will keep our eyes and ears open. If not, she will not be slow in undeceiving us, when we prefer our own way to hers. How often we must remember the art of the surgeon, which, in replacing the broken bone, contents itself with releasing the parts from false position; they fly into place by the action of muscles. On this art of nature all our arts rely."—*Emerson.*

Abdominal surgery is no longer a pioneer work. It is the result of the accumulated experience of the past fifty years. Its success is based on well-tried processes. It is a jealous field, filled with battles lost and won, dotted here and there with sad regrets, chagrin from unavoidable mistakes, but often brightened by the light of success. A master-hand in abdominal surgery is a hard-earned reputation. However, the accumulative experience of fifty years has still left obscure points in abdominal surgery, which the genius of Lawson Tait has attempted to set at rest by the exploratory and confirmatory incision

During the past ten years I have been particularly interested in gynecology and abdominal surgery, and all along these years has risen the question of abdominal pain and its signification. To interpret abdominal pain requires the best skill of the finest heads.

Location.—How far can we diagnose abdominal pain by its locality? Only to a limited degree. Associated circumstances must aid in the diagnosis. There are three common localities of acute abdominal pain, or peritonitis,—viz., pelvic, ceco-appendicular, and that of the gall-bladder region; and as probability is the rule of life, it is well to diagnose acute abdominal pain as a disturbance in one of these three localities of the peritoneum.

Acute abdominal pain in general is referred to the navel—in other words, to the region immediately over the solar plexus or abdominal brain. Acute abdominal pain is due to a disturbance of the peritoneum, owing to a lesion of an adjacent viscus; but since the peritoneal pain can arise from many organs and from several points of the same organ, it demands the most experienced diagnostic acumen and the most mature judgment to interpret the significance of the trouble. No one can decide what kind of wood lies under a table-cloth. I have repeatedly observed in appendicitis that patients say the acute pain, especially in the beginning, is over the whole middle of the abdomen (solar plexus). This may be due to excessive and violent peristalsis of the small intestines. As regards locating the pain at any point of the small intestines, it cannot be done, first, because the loops of intestine have no distinct order as to locality; second, the patient cannot discriminate a point of pain at any given point—perhaps from lack of practical experience. With few exceptions, to locate the seat of trouble in acute abdominal pain, we call to our aid the pain elicited by pressure. Pressing the abdominal walls produces a distinct localized tenderness or pain which suggests localized pathology. Again, rigidity or tension of the abdominal wall is suggestive of a pathologic locality. This symptom is purely reflex, due to irritation passing from the involved viscera to the spinal cord, whence its irritation is transmitted to the periphery of the lower intercostal nerves which control the abdominal muscles over the seat of pain. Dashing cold water on the belly will produce similar protective muscular rigidity. Hence, in general, the location of disease in the abdomen from the patient's feeling of sudden acute pain, is quite indefinite. But local tenderness and local pain on pressure aid very much. Localized rigidity of the abdominal wall is suggestive that such tension is protecting the seat of disease from motion, further bacterial or fecal invasion. In short, the rigid muscles are putting the pathologic parts to rest.

Vomiting is a general characteristic of sudden acute abdominal pain. In sudden acute abdominal pain, from vis-

ceral lesion, Nature makes profound effort to manifest its distress, but to diagnose the seat of pathology and nature from the localization of the pain requires much reading between the lines from experience and judgment.

Again, a vast difference arises between sudden acute abdominal pain and the abdominal pain which comes on slowly. Much depends on the stage of the disease in which the physician first visits the patient.

The signification of sudden acute abdominal pain may be realized better by a short consideration of some of the principal conditions which occasion it.

The first class of sudden acute abdominal pain chiefly arises from the digestive tract; the second class from the genito-urinary.

(1) In the category of the causes producing sudden acute abdominal pain in the digestive tract, we place intestinal obstruction from (a) strangulation by bands and through apertures; (b) invagination; (c) volvulus, and (d) perforation. The mode of onset in all of these is sudden and violent and nearly always accompanied by vomiting.

Strangulation by bands and through apertures constitutes one-third of all intestinal obstructions. If the bowel loops slip through an inguinal or femoral aperture, digital examination will detect the cause of the sudden, acute abdominal pain. Obturator and sacrosciatic hernia are seldom diagnosed, so that practically they would come under internal strangulation by peritoneal bands. Sex does not aid in diagnosis, for males and females about even up in peritonitis during life, and hence will possess about the same amount of peritonitic bands to strangulate bowel loops.

A history of previous peritonitis tells the story of strangulation by bands. Vomiting is violent, pain from peristalsis is periodic and general over the abdomen. The pain is not due to stoppage of the fecal current, but to reflex irritation of the bowel at the seat of obstruction. Temperature is not conspicuous and the pulse is not much changed. Tympanites arises in exact proportion to the peristalsis of the bowel wall above the seat of obstruction. At first the pain is vio-

lent, but it subsides with the progress of the case, becoming more continuous and generally diffused. If the patient be quiet, the pain is so slight that it deceives the most elect. No stool, no gas per rectum, no detectable swelling at any hernial aperture with continuous abdominal pain and vomiting, demand surgical notice. The temperature and pulse are not reliable. Strangulation by bands will generally give no tender location on pressure and no detectable swelling; and, in fact, I have watched cases with the abdomen quite soft and pliable, with no possible physical point of diagnostic value, not even tympanites. In one case the pain was at first severe, general, and almost subsided the day before the operation, yet fifteen feet of gut was as red as a sunset. The sudden, acute abdominal pain, is not due to the constricting band, but to reflex irritation transmitted to the abdominal brain, where reorganization occurs, whence it is emitted to the whole digestive tract, inducing violent, disordered and wild peristalsis (colic).

Acute, sudden, abdominal pain, due to a constricting peritoneal band, is one of the most obscure matters to interpret. To explore the abdomen in the proper time for such a case requires a wise diagnostician and a bold surgeon. The matters to bear in mind in strangulation by bands are, the acute, sudden abdominal pain with a violent onset, vomiting, and the distinct colicky, peristaltic, periodic character of the suffering, not forgetting a previous history of peritonitis. However, the sudden, acute abdominal pain, arising from strangulation of a loop of bowel by peritonitic bands, is difficult to interpret and seldom diagnosed. It may be asserted, that when a patient is suffering from some grave disease, manifest only by sudden acute abdominal pain, the nature of which cannot be interpreted, an early exploratory laparotomy is justifiable and demanded. Such obscure cases require an experienced surgeon, skilled in abdominal work, to meet any emergency. I remember very distinctly the case of a man about forty, who gave consent to my colleague, a general practitioner, who was entirely untrained by experience or observation in abdominal surgery. The doctor told me he opened the abdomen and

found a band stretching tightly across the ascending colon. But he said "the colon was black, and I did not know what to do with it, so I closed the abdomen." It is needless to say that the man made a prompt, fatal exit. But most cases die undiagnosed. The danger of strangulation by bands is gangrene and perforation

Invagination constitutes about one-third of all interstitial obstructions, and the sudden acute abdominal pain arising from this cause is more easily interpreted. Age signifies much in this case, for one-fourth of all invagination occurs before the end of the first year of life, and one-half before the end of ten years. Invagination is a disease of childhood. Its mode of onset is sudden and often violent. From some twenty-five experiments in invaginating the bowel of the dog, I am sure the pain is periodic at first. The griping, colicky peristalsis is rhythmic, depending on irritation. At stated times the dog suddenly spreads wide his four feet and arches his back, appearing in severe distress, then gradually recovers his natural attitude. In invagination blood occurs in the stool in 80 per cent. of cases (especially children), and the vomiting is not violent nor even always conspicuous, for the bowel is only partially occluded. Seventy per cent. of invaginations occur at the ileo-cecal apparatus—that landmark in man's clinical history—15 per cent. in the small intestines, and 15 per cent. in the large bowel. Invagination is manifestedly abdominal pain similar to a long enterolith in the bowel which in turning leaves small spaces at its side for the passage of gas and some liquid stool. I have, unfortuntely, watched a case of enterolith day after day, not being able to interpret the abdominal pain or to diagnose the case, until gangrene of the bowel occurred at the seat of the enterolith, when nature asserted sufficient manifestation to induce me to explore the abdomen, but with a fatal result. The most skilled of abdominal surgeons repeatedly examined this case, but could not interpret the acute abdominal pain, which came on suddenly, though as the days glided on it quietly subsided. The patient was a physician, but could not localize any abdominal pain; it was diffuse. Temperature was about 99½° and 100° F., and the pulse was 85

to 95 almost the whole week of illness. The abdomen was generally soft and not tympanitic. Very seldom can an abdominal tumor be felt in the bowel-invagination. Shock in young children is quite conspicuous, yet I personally know of two autopsies in infants, who were attended in life by three of the most skilled Chicago abdominal surgeons, yet in neither case was the diagnosis of invagination made, which the post-mortems revealed as the cause of death. A skilled and experienced physician, such as was the late Dr. Jaggard, took an eight months' infant and stripped off the clothing to be more thorough in examination, and yet, after all his diagnostic skill, failed to locate disease in the bowels. The child was very pale, cried a little, and died thirty hours after the attack. The autopsy revealed ileo-cecal invagination.

Sudden, acute abdominal pain in a child, may with high probability be interpreted as invagination, especially if one can detect the periodic, peristaltic character, its colicky nature. Blood following in the stool is almost pathognomonic. A tumor will rarely be found, and pressure on it will not generally elicit tenderness. It is not at all likely that the patient can locate the seat of the disease from the pain. Tympanites and vomiting are not conspicuous, and the temperature and pulse are unreliable. The danger of invagination is sloughing of the apex or neck and consequent perforation. Invagination presenting at the anus interprets easily the cause of the pain. Volvulus is so rare that it constitutes about one-fortieth of all intestinal obstructions, and occurs about four times as often in men as women. As in invagination so in volvulus, I was always compelled to suture them in position in a dog. But I never succeeded in establishing a permanent volvulus in the dog. Volvulus is characterized by tympanites, and it is said by severe periodic pain. Volvulus occurs at the sigmoid in 60 per cent. of the cases; at the ileo-cecal valve in 30 per cent., and in the small intestines in 10 per cent. I have seen partial, but never complete, volvulus in man. Senn operated successfully on a man, on the eighth day, for sigmoid volvulus. He put a tuck in the mesosigmoid. Seven years

later another physician operated on the same man for volvulus, but he died. The man had enormous tympanites; his pain is not described as severe, but no doubt the suffering is severe.

At first the pain is periodic, but as time advances it becomes more constant, with now and then exacerbations. Vomiting, though not conspicuous, must arise more or less from trauma to the peritoneum. Perhaps the sudden pain, chronic constipation, and rapid rise of tympanites would aid in interpreting volvulus, but seldom can one diagnose such a disease. Pain no doubt would be referred to the abdominal brain. Most clinicians note tympanites as a conspicuous feature of volvulus.

In perforation it is very difficult to interpret the sudden abdominal pain. Associated circumstances would aid. In typhoid fever one would naturally suspect perforation if sudden acute abdominal pain arose, and my colleague, Dr. Van Hook, successfully operated on a typhoid perforation diagnosed by his medical friend. One might think if he was called to a young woman with sudden acute abdominal pain that it was a round, perforating ulcer of the stomach, after excluding pelvic and appendicular disease. But the sudden acute abdominal pain of perforation is so vague and indefinite that only an exploratory incision would interpret it

The sudden acute abdominal pain from appendicitis (perforation) is more apt to be diagnosed. Now probability is the rule of life, and when one is called to a boy or man up to 35 with sudden acute abdominal pain, it is likely appendicitis. The pain of appendicitis is at first sudden and generally diffuse, and in appendicitis this is, in my experence, a characterstic and conspicuous feature. The sudden acute pain in appendicitis is doubtless due to violent appendicular peristalsis (colic), or to the rupture allowing the bowel contents to come in contact with the peritoneum, and also inducing violent irregular peristalsis of the adjacent bowel loops. Rigidity of the abdominal muscles over the seat of pathology in appendicitis is a great aid to interpreting the pain. The muscular rigidity is protective and due to the

transmission of the visceral irritation to the spinal cord, which is reflected to the abdominal muscles. There is a nice balance between the peripheral visceral and the peripheral cutaneous nerves in the abdominal muscles. Local tenderness and local rigidity of the abdominal muscles is a great aid in signification of the sudden acute pain in appendicitis. It might be well to suggest that the position of the appendix is located all the way from the under surface of the liver to the floor of the pelvis, and also many times where there was more or less of a mesenterium commune, the cecum turned towards the vertebral column, and the appendix is then liable to lie among the small intestines—the dangerous ground of peritonitis. It is likely that the pain in appendicitis depends on the seat of the disease—i. e., the mucous membrane has become ulcerated, inducing appendicular colic (peristalsis), while the sudden exacerbation of violent diffuse abdominal pain is due to the involving of the peritoneum itself. I see nothing especially worthy of attention in the so-called McBurney point. Pain over the seat of disease is certainly a natural feature, and generally the appendix lies under a point midway between the umbilicus and anterior superior spine of the ileum. But it is not always so by any means, for I examined with great and anxious care, a short time ago, a young physician with severe pain over the so-called McBurney point, when on operation the long appendix was down in the pelvis and perforated. Then, again, pain on pressure may be reflex, bobbing up in remote regions of the abdomen. The sudden, acute, diffuse abdominal pain arising in appendicitis, generally subsides into the right iliac fossa after thirty-six hours, and one can nearly always elicit pain on pressure there. This pain on pressure is doubtless the motion transmitted to a sensitive, inflamed peritoneum, and not the dragging on an adhesion, as some assert, for adhesions so newly formed can have no nerves formed in them. But man is subject to appendicitis four times as frequently as woman, due, perhaps, to Gerlach's valve being small in man, and thus not allowing the foreign body to escape after entrance, or due to the greater activity

of the psoas muscle in man. The appendix lies on the psoas muscle in man more frequently than in woman, and on its longest range of activity, hence when the appendix contains virulent and pathogenic germs the long range of action of the psoas so traumatizes the appendix that it induces the escape or migration of the accidental virulent pathogenic microbes through the appendicular walls into the peritoneal wall or cavity Common sense and experience would dictate that the pain on pressure would occur in any point of the abdomen possessing inflamed structures. Since probability is the rule of life it is well to look to the three great regions of dangerous peritonitis—viz., the pelvic, appendicular, and gall-bladder regions.

The digestive tract has still another common seat for sudden acute abdominal pain, and that is the gall-bladder region. The sudden acute abdominal pain in hepatic colic is not generally so violent as many others accompanying acute diseases of the digestive tract. Patients relate that the pain is aching, dragging, and in the active stage cutting or tearing. Some relate a feeling of tightness or fulness. But it depends on whether the stone is attempting to enter the mouth of the duct or whether it has already entered. I have had typical cases where operation proved that the stones only attempted to enter the duct. No doubt these are the cases which say so often that they have some severe pains at any time, but especially after taking hot meals, or hot or stimulating drinks; whence arises excessive peristalsis, inducing short, temporary hepatic colic. Now, when the gall-bladder has many small stones in it, and when one more or less often attempts to engage in the neck of the gall-bladder, the pain is rythmical. It begins slowly and rises to a maximum. At the maximum the pain is intense. We have observed such cases and afterwards operated on them, removing many small stones. Gall-stones are perhaps four times as frequent in women as in men; why, we do not know. In my experience patients can generally localize the pain in gall-stones more accurately and definitely than almost any other sudden acute abdominal pain. They refer the pain to its proper locality: however, I must admit

that this reference is before rupture. After rupture of bladder or duct the pain is indefinite, like other perforations. The sudden acute abdominal pain in gall-troubles is characterized by more slowness, less acute intensity and distinct periodicity, than invagination, appendicitis, or perforation of the digestive tract. Jaundice is not necessary. Jaundice depends on the color of the eyeball, and not of the skin. A feature in gall-bladder pain is that it extends well towards the dorsum. Age aids in diagnosing stone in the biliary passages to some extent.

In renal (genito-urinary) colic it must be said that the pain resembles that of hepatic colic in many ways, the rhythm being paroxysmal. It intermits and is often agonizingly spasmodic. It requires much careful study to differentiate the sudden acute abdominal pain in hepatic and renal colic from each other. This is important, for the plan of action is very different. The pains in appendicitis, renal, and hepatic colic are in close relation.

The sudden acute abdominal pain arising from the genitals is more easily interpreted and managed. The pain can be more definitely located by the patient; and sudden disorganization of viscera, being accessible in the pelvis, is much more within control of the gynecologist. The sudden acute abdominal pain from the genitals is generally due to a ruptured ectopic pregnancy, or the very rare matter of the rupture of a pyosalpinx into the peritoneal cavity. Most other pelvic pains are of slower origin and almost always diagnosable. Sex and the reproductive age aid in the interpretation of the case.

Remember the three dangerous peritonitic regions—viz., pelvic, appendicular, and gall-bladder.

In regard to the character of sudden acute abdominal pain, it varies as to its mode of attack, and as to the viscera attacked.

If one will closely watch the sudden acute abdominal pain, it will be quite apparent that the character of the pain in most of the acute affections of the abdomen is very similar. We only observe in reality a difference in degree of pain from the bearable to the agonizing. In perforation the

character of the pain is the same in all viscera. In invagination it is paroxysmal and periodic, at least at first, due to irregular and violent peristalsis. In internal strangulation it is generally intense and periodic, due to violent peristalsis, later continuous and of an aching, dragging character, due to paralysis of bowel segments. In appendicitis the pain is nearly always sudden and intense—i. e., the perforative variety. The variety of appendicitis with slowly increasing pain is likely lymphatic in invasion and not dangerous, simply medical, though of course the appendicular mucosa may be perforated. Sudden, acute abdominal pain of a lancinating character, and quite continuous, is very likely to be due to perforation of the appendix or digestive tube, and the continuous, agonizing character of the pain is a heraldic symptom of diffuse peritonitis, the knell of life. It may be remembered that the character of the sudden acute abdominal pain will depend on the capacity of any viscus for peristalsis—i. e., its capacity to cause colic by violent, wild, irregular muscular action. In peristalsis periodicity must not be lost sight of, and the etiology which gives rise to the irritation, inducing the peristalsis. It may be transitory in character, as food irritation, rapidly forming and reducing invagination, or a stone attempting to enter a duct. Or the pain may be continuously periodic, as a stone lodged in some canal, appendix, ureter, small intestine, or biliary duct.

In regard to the location of sudden acute abdominal pain we have to consider (a) the seat of pain as felt by the patient; (b) the pain elicited by pressure (tenderness); (c) local rigidity of the abdominal muscles; and (d) anesthetic or hyperesthetic condition of the skin of the abdomen.

In general, sudden acute abdominal pain is referred by the patient to the umbilical region, to the solar plexus, directly over the abdominal brain. This, in my opinion, is a nervous center, possessing the power of reorganization, of receiving and transmitting forces, of controlling visceral circulation and of inducing reflex or referred pain. The irritation of peripheral visceral nerves is transmitted to the abdominal brain, whence reorganization may take the pain

over the abdominal brain, at the seat of disease or at a remote abdominal point, due to a supersensitive nervous system.

As to local tenderness or pain elicited by pressure, it indicates a pathologic condition of the peritoneum (inflammatory). The pain is induced by motion or disturbance communicated to a sensitive inflamed peritoneum.

Local rigidity of abdominal muscles indicates adjacent underlying disease of organs supplied by the same nerves as the muscles which exercise a protective agency, to preserve rest for damaged tissue, to assume repair, and to prevent further destruction from motion. Hyperesthesia or sensitiveness of the skin, due to transmitted irritation, is often present, but is not very reliable as to locality, for it is dependent on peculiar symptoms, and accompanies, more or less, though irregularly, most acute abdominal affections. Of course, it would be expected that the severe, sudden, acute pain in the kidney and gall-ducts, being very near to the abdominal brain, would be difficult to separate from the solar plexus. Lead-colic may deceive the most elect as to its etiology or seat.

CHAPTER XIII.

THE SYMPATHETIC RELATION OF THE GENITALIA TO THE OLFACTORY ORGANS.

"It is when you come close to a man in conversation that you discover what his real abilities are."—*Samuel Johnson.*

It is a curious fact that even laymen have for ages noted that the organ of smell is closely related to the generative organs, but it is very recently that specialists (gynecologists and rhinologists) are putting together the connected story. The relations of the olfactory organ and nasal mucous membrane with the genitals are by way of the sympathetic. The anatomic paths of travel from the nasal mucous membrane with the genitals are by way of the sympathetic. The anatomic path of travel from the nasal mucous membrane to the genitals is through the fifth cranial nerve or trigeminus—a sympathetico-cranial nerve. The trigeminus is supremely the ganglionic cranial nerve. It is the type of mixed nerves. It has eight ganglia situated on its branches. It also sends a large branch to the mucous membrance of the nose—the nasal nerve. This will at once explain its wide influence in reflection or disease, because of its extensive influence over the caliber of adjacent blood and lymph-vessels, and the extensive periphery in the nasal mucosa, allowing opportunity for numerous reflexes.

Let us examine for a moment the ganglia of the trigeminus (trifacial) or fifth cranial nerve—the ganglionic nerve of the brain. A significant statement may precede the short description, by saying that one of the chief offices of a ganglion is to demedullate nerves. 1. We may note the Gasserian ganglion of the fifth cranial nerve, situated in a depression in the apex of the petrous portion of the temporal

bone. The ganglion is as large as the end of the little finger. The ganglionic nature of this swelling was first perceived by Raimund Balthasar Hirsch, a Vienna anatomist, in 1765, who christened it the "ganglion Gasserii" in honor of his teacher, Gasserius, who in 1779 was "Privat Docent" in anatomy under Prof. Joseph Jans, in Vienna. Since Du Bois-Reymond announced from personal experience that he thought facial neuralgia was due to spasmodic contraction of the blood-vessels controlled by the sympathetic, surgeons have attempted to cure facial neuralgia by destruction of Gasser's ganglion. This is at least a recognition of the sympathetic nature of the Gasserian ganglion, and its consequent influence over the caliber of the blood-vessels.

The Gasserian ganglion has close and intimate connection with the sympathetic nerves. The blood-vessels alone, which are necessary to supply the Gasserian ganglion, would produce a close and intimate relation between the sympathetic and trifacial. The trigeminus shows a very intimate and extensive connection with the tonsils, the sebaceous glands of the face and the genitals. This is seen at puberty of both boys and girls (facial acne), and in the menopause. The changes in voice of boys at puberty, and the changes of voice of women at the monthly, may be easily worked out anatomically, by dissecting out the connection between the superior cervical ganglion and the pneumogastric and glosso-pharyngeal. Also the spheno-palatine ganglion sends branches to the tonsils in the descending palatine nerves. One may find three to five branches of nerves passing from the superior cervical ganglion to the glosso-pharyngeal and pneumogastric nerves. During menstruation the vocal cords are congested and hence the hoarse, husky voice; and a similar but permanent physiological process of congestion and growth occurs in the boy at puberty. Hence the close and intimate relations of the vocal cords (voice) and nasal mucosa (smell) and reflex action with the genitals, have a distinct, concrete, anatomical explanation. Besides, the larynx is supplied by the sympathetic branches which accompany the superior and inferior recurrent laryngeal nerves.

2. The ophthalmic, lenticular or ciliary ganglion is a pin-head sized ganglion situated in the orbit. It is closely connected by roots with the nasal branch of the fifth nerve, i. e., has relations with the nasal mucosa, by a sympathetic branch from the cavernous plexus. It is also connected with the third cranial. This second ganglion has intimate connections with the nasal mucosa.

Joseph Guiscard Duverny (1648-1730), a French anatomist, discovered this ganglion.

3. The spheno-palatine, or Meckel's ganglion, situated in the spheno-palatine fossa and on the superior maxillary branch of the trifacial, is a large mass of nerve-cells. It is intimately connected with the nasal mucosa by the descending palatine nerves. The spheno-palatine ganglion was discovered and described by Johann Friedrich Meckel (1717-1774), a celebrated German anatomist. Like all the other ganglia of the fifth cranial nerve, it possesses motor, sensory and sympathetic roots. It sends a considerable nerve-supply to the tonsils. Hence, we again observe that this ganglion shares in distributing nerves to the nasal mucosa and the region of the tonsils. But the premise of our argument is that the fifth nerve, being studded by eight sympathetic ganglia, is intimately and closely connected anatomically and functionally with the genitals. Therefore, what affects the fifth nerve will affect the genitals, and vice versa.

4. The otic or Arnold's ganglion is located just below the foramen ovale, on the inferior maxillary branch of the trifacial. Its sympathetic branches are derived from the sympathetic plexuses which surround the adjacent middle meningeal artery. It is connected with the facial and glosso-pharyngeal nerves and sends branches to the tensor palati. In our library may be seen Friedrich Arnold's "Anatomie des Menschen," 3 Vols. On page 909, Vol. II, Arnold says, "Der Ohrknoten wurde von mir im Winter 1825-26 endeckt." In English, "The optic ganglion was discovered by me in the winter of 1825-26." Professor Arnold noted 75 years ago that many tried in vain to show that others than himself discovered the ganglion. This ganglion shows

connection with the larynx by way of the glosso-pharyngeal and tensor palati; and, through the Vidian nerve and Meckel's ganglion, with the nasal mucosa.

5. The submaxillary ganglion is situated on the lingual branch of the inferior branch of the trifacial nerve. Its sympathetic branch is derived from the plexus which surrounds the adjacent facial artery. This ganglion was discovered by Meckel in 1748. It has been named after him, ganglion Meckelii minus. The ganglion communicates with the facial or the seventh nerve.

6. The sublingual or Blandin's ganglion is situated on the branch of nerves going to the sublingual gland. This collection of nerves may be only a plexus or a ganglion. It should have a similar connection with the submaxillary ganglion. Philippe Frederic Blandin (1798-1849), a French surgeon, first described this ganglion in 1840.

7. The ganglion of Bochdalek is located at the junction of the middle superior dental nerve with the anterior superior dental nerve. It is not constant, and besides the swelling may not always be a ganglion, i. e., may not contain nerve-cells. It lies above the upper canine tooth. Its discovery is due to Victor Alexander Bochdalek, Professor of Anatomy in Prague until 1869 (papers published in 1866) and Victor Bochdalek, his son, also an anatomist in Prague. However, it appears to be the father who discovered this ganglion, for I find in Arnold's Anatomy that Bochdalek had observed this ganglion previous to 1851.

8. The ganglion of Valentine is situated at the junction of the middle superior dental with the posterior superior dental nerve. It is located above the second bicuspid tooth. The ganglion was discovered by Gabriel Gustave Valentine (1810-1883), a German anatomist. All the ganglia of the fifth cranial or trifacial have systematic connections.

We have shown first that the trigeminus is a supremely ganglionic cranial nerve, that it is closely and intimately connected with the genitals by way of the sympathetic tracts; also that the trigeminus is closely and intimately connected, especially with the nasal mucosa, and to a considerable extent with the larynx and vocal cords. There

are found to be numerous and intimate connections between the fifth cranial nerve, the trigeminus, and the seventh cranial nerve, the facial. Observation shows the intimate and close relations of the genitals with the voice, nasal mucosa and the facial sebaceous glands, at puberty and menstruation. This close connection and intimate relation is accomplished by means of the sympathetic nerves, especially the ganglia on the trifacial. This physiologic relation of the genitals to the trifacial and facial nerves, may be plainly observed in the sexual relations and cohabitations of animals.

Irritation of the nasal mucosa will cause congestion and erection. Occasionally irritation of the genitals will cause congestion of the face or the region of the trigeminus. Urethral irritation will induce "gritting" of the teeth, i. e., action of the masseter muscles, supplied by the inferior branch of the fifth.

Dr. A. G. Hobbs describes two cases of severe priapism accompanying acute rhinitis (Jour. Amer. Med. Assoc., 1897). On spraying the nasal mucosa with cocaine the priapism immediately subsided. Opium affected the priapism in each case, but only to a slight degree.

A reflex sneeze is not infrequent previous to erection. In preparations for coition the involvement of the nasal mucosa is quite apparent in animals, as the horse, dog, bull, etc. In monkeys the nasal mucosa is not only involved in coition, but it is evident the larynx is highly involved, from the active and vigorous chattering, emitted previous to and during coition. The mare neighs at the approaching of the stallion; the growling of dogs, noise of cats and cackling of hens, are doubtless not accidental at times of coition, but due to irritation of nerve tracts.

The tissue covering the turbinated bones is quite erectile. A nasal reflex will induce an erectile action in the corpora cavernosa. We know that the genitals are intimately and profoundly supplied by the sympathetic nerves. We know that the fifth nerve is the supremely ganglionic (sympathetic) nerve of the brain. The fifth nerve sends a rich supply

to the nasal mucosa and to the larynx, through the vagus and glosso-pharyngeal.

Clinically and anatomically we note a close and intimate relation existing between the genitals and the nasal mucosa, the larynx and the sebaceous glands of the face. The whole manifestation is due to reflex action carried on through the sympathetic nerves. The frequent hemorrhages from the nose during and subsequent to puberty, in both sexes, demonstrates the intimate relation of the nasal mucosa to the generative organs. The vicarious hemorrhage, sometimes assumed by the nasal mucosa, shows the close relation of the genitals and nasal mucosa. Again, why is it that so many women we note with chronic uterine disease also have rhinitis in different forms. A typical example came to my office a few days ago. She was 24 years old and single. At 20 she began to be irregular in the menstrual function, and to have menorrhagia. Digital examination revealed a quite large, hypertrophic, metritic uterus, fixed by old adhesions, with distinct retroflexion. She said she bled frequently at the nose. The tissues covering the turbinated bones were thickened, inflamed and congested. Chronic rhinitis and metritis co-existed.

Many diseased generative organs co-exist with diseased nasal muscosa. The eight ganglia on the fifth cranial nerve, (1) Ganglion Gasser; (2) Ophthalmic; (3) Spheno-palatine; (4) Otic; (5) Submaxillary; (6) Sublingual; (7) Bochdalek; (8) Valentine; not only show the sympathetic nature of the fifth cranial, but also its intimate relation with the nasal mucosa, larynx, abdominal brain, and especially with the genitals.

THE END.

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